Reconstruction Number

Electrical World

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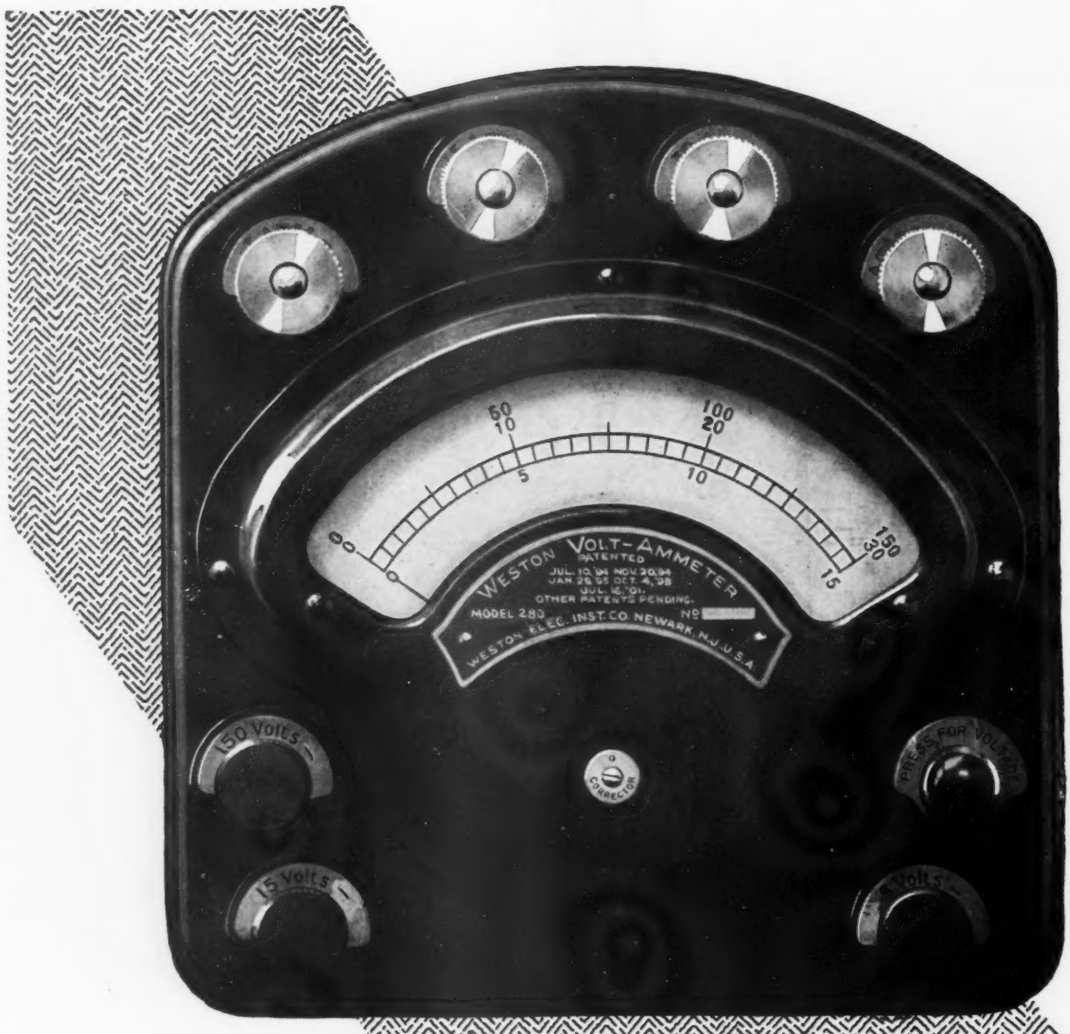

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

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The Outlook in Electrical Industry

THE rôle of the prophet is a very unsafe one and never more perilous than now when the world is emerging, gasping for breath, from the raging whirlpool of a colossal war. The Central Powers at the moment present no government with which any permanent peace can be made, nor any immediate prospect of such a government as will not be imperiled or overthrown by counter-revolutions to the utter demolition of its international agreements.

As a feature of the industrial outlook the fact arises that the world generally has been indulging in a wild orgy of monetary inflation. Each country, with Germany in the lead, has in effect pyramided in its finances, so that the net result is not very different from what would have been reached by the issue of very large amounts of irredeemable paper in quantity bearing some unknown and irregular relation to the funds which have been raised. Our own country, while more conservative than some others, has become a victim of the general tendency, with the result that prices of commodities and especially of labor have reached planes hitherto undreamed of, even in the wildest speculative days of the Civil War, when gold was on the rampage with quotations between 200 and 300. With the approach of peace and the return of millions to civil life or employments unconnected with war, the period of stabilization must necessarily be a hazardous one.

Under these circumstances the thing to be asked regarding the electrical industries is whether they are likely to ride on the crest of the wave or wallow in the trough. Our judgment, on the whole, is that the outlook is good rather than bad, for the fundamental reason that with all the changes in conditions electrical supply, which is the basis of the demand for electrical goods of every sort, has become steadily more and more necessary to whatever forms of industry may at any time be dominant. The mere fact that fuel prices are likely to remain high for a long time, and perhaps never sink to the pre-war plane, points to the growth of electrical supply in bulk as the remedy for high power costs. Throughout the course of the war the central stations have very generally been called on for output up to the limit of their production, output indeed demanded largely by war industries, but for this purpose withdrawn from its ordinary course of distribution. So far as electrical supply goes, it is the total quantity demanded which in the long run counts rather than any special distribution of this demand. Unless, therefore, there is a general collapse of industry, the supply stations will merely find that the character of their load will change without any serious shrinkage.

Another important matter is that war conditions have forced a great development of electrical supply in bulk and through the medium of widely extending interconnected networks. The establishment of supply in such wise brings with it an increasing opportunity for large and profitable use of electrical energy. As one of the by-products of war conditions, too, there has been a necessary slackening in general building operations. The stress now having been removed, builders will begin even at present prices to make up for lost time, bringing with their activities renewed electrical demands. And beyond all this there is the broad fact that anything which has the large and well-established economic value of electrical supply does not, even in hard times, suffer to the extent of industries less necessary in the world's affairs.

For some time there will be no inconsiderable opportunities for export trade in electrical equipment, because the element of time in deliveries will overweigh to a considerable extent the added costs of production in this country. Material must be had to reëstablish the equilibrium of the world's manufacturing, and when it cannot be obtained from one source it will be from another, even at added expense. For the larger use of electrical material therefore we have little fear.

Looking at the whole matter in a large way, it seems to us that the electrical supply industry, with all the ramifications of manufacture which that implies, is likely to push steadily ahead in spite of sudden upheavals in industrial life, at a good rate of progress. Now if ever is the time for commercial and engineering departments to busy themselves with adaptation to a change of requirements. All the multifarious branches of electrical manufacture which depend upon the central stations' prosperity are likewise due to advance with just the same qualifications here expressed. Only here and there will there be found lessened demand caused by changes that come with impending peace. These unfavorable situations will, on the whole, we think, be less numerous and serious than in most branches of manufacture. The safe course to pursue in the electrical industries at large is to drive along steadily on the theory that a greater need than ever for electrical help has been fully demonstrated, that rapid shifts in the nature of the demand may be fully expected, and that in this particular it is the spirit of quick adaptability that wins out—an adaptability which has never been lacking in electrical enterprises and will not be.

Their Old Jobs Ready for Them

Reawaken the American Mind

Need of Clear Vision with Our Thousandfold Increase of Responsibility in World Affairs—Let Us Demand Such a Degree of Excellence from Schools and Colleges as We Have Demanded in Industrial Achievements

BY B. A. BEHREND
Consulting Engineer, Boston

AMERICA is the country of achievement. It is perhaps more than a mere epigram to say that, while from England and France we have obtained ideas and inspiration, from the Germans methods, America has been the field of achievement. It is idle to repeat, as every one constantly sees the numerous superlatives in our industrial life—the greatest railroads, the greatest water-power development, the greatest power-transmission lines, the greatest electric generators, the greatest steel mills; but we may well add to it that in this war now at an end we have proved our warlike powers of achievement and we have raised a gigantic army in a stupendously short time, and an army of quality and individuality and manhood which it is the writer's firm conviction was not only the equal but the superior of other armies in the field.

America thus stands essentially for the idea of achievement and accomplishment of great tasks and problems, be it the achievement in popular government inaugurated by the founders of the Union and tested through the fires of civil war and again recently in a foreign war, or be it achievement in the industrial field.

We are told now that the world has entered upon an era of reconstruction, and it is probably only too true that Europe has crucial years to pass through; but it is not at all clear that such a period of economic reconstruction is at hand in this country. On the contrary, it is hard to see that the name of reconstruction can be justly adapted to the conditions before us. We have to make a shift from a country organized in an incredibly short time as a huge war machine to a country adapted to the pursuit of industry and trade.

So far as the author of this article is concerned, it seems to him that there is only one great issue which the country should carefully ponder, and this issue is not an industrial issue so much as it is the thought which, through an attitude of introspection, might suggest itself to a spectator.

On the founding of the great Johns Hopkins University in Baltimore in 1876 a great and brilliant Englishman was asked to deliver an address. From this address of Thomas Henry Huxley we quote the following lines:

> To an Englishman landing upon your shores for the first time, traveling for hundreds of miles through strings of great and well-ordered cities, seeing your enormous actual and almost infinite potential wealth in all commodities and in the energy and ability which turn wealth to account, there is something sublime in the vista of the future. Do not suppose that I am pandering to what is commonly understood by national pride. I cannot say that I am in the slightest degree impressed by your bigness or your material resources as such. Size is not grandeur, and territory does not make a nation. The great issue, about which hang a true sublimity and the terror of overhanging fate, is, What are you going to do with all these things?
>
> What is to be end to which these are to be the means? You are making a novel experiment in politics on the greatest scale which the world has yet seen. . . . Truly America has a great future before her—great in toil, in care and in responsibility, great in true glory if she be guided in wisdom and righteousness, great in shame if she fail. I cannot understand why other nations should envy you or be blind to the fact that it is for the highest interest of mankind that you should succeed; but the one condition of success, your sole safeguard, is the moral worth and intellectual clearness of the individual citizen.

"What is to be the end to which these are to be the means?" This is the question Professor Huxley asked, and it is, two score years later, the question which we all must ask. With the tremendous powers for good and evil which the people of this country possess, having been the arbiters of the world in the great war just at an end, it is a matter of the utmost importance that their vision be as clear and dispassionate as it is possible for the human mind to be, and such clear vision can be obtained only through the best possible instruction in our schools and colleges. In other words, as our capacity for achievement is greater than the capacity of achievement of any other country in the world, not even excepting Great Britain, our instruction and our intellectual clearness should be, to say the least, the equal of those of Great Britain.

If we apply this standard to the teaching in our universities in the particular field with which I may humbly feel acquainted, and in regard to which I may possibly utter competent judgment, one's verdict un-

fortunately cannot be so favorable as it has been in regard to our power of achievement. No better minds, no greater individual energy, no greater assurance and capacity for digestion of learning exist anywhere in the world than in this country, and it is perhaps largely due to these great qualities of our people that we have so far been able to get along with methods of education and limitations of teaching which might have sent almost any other country to the poorhouse. As Lord Viscount James Bryce remarks in his "American Commonwealth," in speaking of Congressional finance, "Her wealth is so great, her revenue so elastic, that she is not sensible of the loss. She has the glorious privilege of youth, the privilege of committing errors without suffering from their consequences."

But our period of youth is not eternal, and our responsibility in world affairs has increased a thousandfold. The time may come, if it has not yet come, when we shall have to give a more thorough and sound training to our engineers in the advanced branches of science and engineering, not to mention the equally important branches of philosophy, history and law; when we must be able to point to American teachers in our universities of the caliber of Henry Bouasse, André Blondel, Paul Appell, Sir George Greenhill, Sir J. J. Thomson, John Perry, Horace Lamb, H. S. Hele-Shaw, A. E. H. Love—in short, that great host of brilliant French and English teachers to whose works we must constantly refer if we would understand our art and our science and make proper use of the great opportunities at our hand.

It is perhaps, as Prof. Vladimir Karapetoff once remarked to the author, asking too much to have embodied in one nation the greatest power for achievement and the leadership of science, but such a vision seems perfectly possible, and to all those who appreciate that possibility it becomes a passionate desire to see the names of American scholars and the authors of American works of science placed in the front rank with those of other nations for the safe guidance of this greatest of all commonwealths and for the glory of America, our country.

In this sense alone may we speak of reconstruction. Reconstruction with us is to be, outside of the adaptation to peace conditions with their consequent problems, a reawakening of the American mind to the tremendous obligations that for the next century America's holding of the balance of power in the world imposes upon American citizens and American statesmen. Let us turn to our schools and colleges and demand a degree of excellence such as we have demanded in our industrial achievements on the largest scale imaginable, with unparalleled and unexampled results.

Then, and then only, may we face the future calmly; thus, and thus only, can we merit our place as the arbiters of the world.

Planning for the Nation's Future

Place of the Pathfinders Is All-Important—Problem of Socialistic Institutions in a Democratic Society Is Yet Unsolved—Government Functions Should Be Evolved and Not Made Suddenly

BY W. L. R. EMMET
Consulting Engineer General Electric Company

THE war has caused an unprecedented manufacturing activity, mainly on lines very different from those of peace, and mainly conducted with very little reference to degrees of economy which could compete in peace times. The stoppage of this production—and much of it must be promptly stopped—will necessarily cause some idleness and confusion, and the high standards of cost which have been established will tend to discourage construction and to reduce the foreign demand for our goods. European nations, impoverished by the war and with depreciated currency, will produce for costs which on a gold basis are relatively very low, and thus forces will work to equalize the financial burden which the war has put upon others more than upon us.

Nevertheless, the channels of normal production have been dammed for two or three years and the pulses of our national energy have been stimulated by the activities of the war, so that it seems probable that we shall quickly return to a vast productiveness. To those who know the resources of science and mechanics reasons to justify a production beyond the scope of our population are always apparent. Every new accomplishment changes the balance, and economy constantly demands that old constructions should be replaced by new and that the scale of activities should be augmented.

It is in this pressing demand for progress that the engineer finds his inspiration, and the better the engineer the greater will be his belief in an endless need for the best engineering. Even bad engineering must

be used because there is never a sufficient supply of good. To many all engineering looks good, and there are few people who receive more undeserved commendation than engineers. In reality much money and labor are unwisely spent on engineering activities and much is left undone which would be very profitable if wisely planned.

Science is always progressive, and progress brings joy and hope to mankind. The institutions and ideals of our country have, more than in other nations, stimulated men of imagination and given them ready opportunity in all walks of life. In our plans for the nation's future we should never lose sight of the need for constant progress or forget that in the bewildering demands of national life mere industry will not suffice, and that the function of the pathfinders is all-important.

The demands of the war have suddenly made necessary a vast increase of governmental activities. The railroads, the wires and the ships have been taken over. All the channels of trade have been controlled and directed, the food supply has been apportioned, and facilities for doing these things have in a few months been created and put into use. To those who have brought themselves to a belief in the socialistic idea of governmental operations of industry these are doubtless matters of confident satisfaction, but to those who believe that governmental operation is in the long run fundamentally uneconomical and unprogressive the situation presents grave problems. But whatever our beliefs may be, a little thought must convince us that, in peace as well as in war, the nation faces many great needs which far overreach the scope or desire of private investment and organization.

Great undertakings demand authority and resources, and for some of our requirements the national government constitutes the only adequate source. It should, however, be remembered that if the government plans and makes secure the financing of certain large enterprises, arrangements might be made by which construction and operation could, under suitable direction, be safely and profitably intrusted to private industry. The belief is quite common that government work is well done and efficient, and much is being published at the present time for the purpose of giving this impression. Credit for the products of private thought, invention and organization are constantly being claimed for the army and navy. Their efficiency is being offered and accepted as an argument for great extensions of government activity.

To those who know government service and private industry the fallacy of such ideas is apparent. Governmental service may have the advantage that it eliminates much that is wasteful in competition, but its great evil is that it largely eliminates the unrestricted competition of individual abilities, and this is the mainspring of progress. Government service, to be safe and honest, must be disciplined and regulated by law, while private industry is governed by trust between man and man, the only natural means through which scope and authority can be effectively apportioned to those who have the force, judgment and knowledge to accomplish and inspire confidence, not in the public, but in the few directly informed of the matter in hand.

Discipline is a great power, but it is distinctly blighting to the imagination, and if we would follow our democratic destiny to its fulfillment, we should use it sparingly and only for purposes where it is necessary.

The socialistic state which is being advocated by many who think themselves democrats is in reality the maximum of government, while true democracy is the minimum. The only success of the socialistic method has been in Germany, backed by an uninterrupted imperial appointing power and all the forces of caste and authority. The idea that it has been truly efficient there is in many respects very incorrect, and we should remember that it has materially helped to lead to the greatest national mistake of history.

The problem of socialistic institutions in a democratic society is as yet unsolved, and governmental functions should properly be evolved and not made suddenly out of the whole cloth. No one is wise enough to embark a nation safely on radically new courses.

These matters are at the present time of vital interest to the engineer. If the government confines its activities to planning, promoting and helping to organize the great activities for which there is such demand, opportunities will be expanded. If, as has been announced by some of its highest officials, it is to own, operate and appoint to the exclusion of private enterprise, America will no longer afford the field for the engineer and inventor which it has in the past. Fortunately, we have good reasons to believe that the American people will in such a great matter do what is wise and expedient, and it may be hoped that, notwithstanding great governmental activities in the regulation of our national affairs, we shall continue to be the most individualistic people in the world. The aim of the socialistic idea is shelter for the incompetent, and that of the individualistic is opportunity for the able. Can we doubt which will best conduct to the advance of a democratic state?

OUT of the war necessity there came a new application of efficiency in dealing with national affairs. As we now face another transitional period—the period of demobilization and reconstruction—we must as a nation prepare to meet its problems in the same intelligent manner in which we dealt with mobilization. We shall need federal administrative agencies to plan industrial return from a war to a peace basis, to direct the order and the progress of the transition. The way in which we meet this problem will determine our progress in the years to come. Great economic advantage awaits the nation that can quickly enter the world's markets with the products of normal commerce. The nation that succeeds will be the nation that wisely directs return to peace production and that avoids friction between labor and capital. Friction can be minimized by providing such standards of working conditions as will insure understanding and coöperation between all persons concerned in the processes of production.—*Grant Hamilton, Director-General of the Working Conditions Service, Department of Labor.*

Manufacture of Power Apparatus in 1919

Desirability of Close Co-operative Working Relationship with Government—Need of Foreign Outlet—Efficiency of Labor Should Increase—No Reduction Expected in Electrical Apparatus Prices Until Raw Materials Are Cheaper

BY CLARENCE L. COLLENS, 2D
President Electric Power Club

THE War Industries Board has proved during the past year the practicability and desirability of a close coöperative working relationship between government and organized industry. Fortunately, the lessons learned will not be entirely lost, and a further opportunity to demonstrate the advantages of such a relationship will be afforded in the Department of Commerce under the plans announced by Secretary Redfield at the recent war emergency and reconstruction conference at Atlantic City. Secretary Redfield has appointed fourteen men from the organization of the War Industries Board to become his personal industrial advisers and to assist in continuing and further developing close coöperative relations between industry and government.

It is hoped that this new coöperative relationship will develop along economic lines, such as continuing the work of conservation and standardization, which has been so efficiently handled by the Conservation Division of the War Industries Board, and will also promulgate policies which will assist in fortifying business in this country against foreign competition in world markets.

The results obtained by organized industry during the last two years are also bringing an enlightened public opinion toward trade organizations in general and the desirability of close coöperation between business men under government supervision. Much can be done by coöperative effort and concerted action on the part of competitors, which is in the public interest and produces economic benefit to all concerned. Eliminating unnecessary styles, sizes, types, finishes, etc., is a good example of economic benefit both to the consumer and to the manufacturer. I do not believe that the American public will long be satisfied without some modification of the Sherman anti-trust law which will permit, under proper government supervision, concerted action and agreements among manufacturers or business men to the extent that such action is in the public interest, will stabilize business, eliminate destructive, wasteful competition, remove unnecessary financial risks, conserve labor, materials or capital employed, and promote giving the greatest service in the most efficient, most economical manner.

During the next year this country faces extensive liquidation in almost every line of endeavor, and close coöperation between organized industry and government will be necessary to reach equitable solutions. The government now has on hand, and will not require, machine tools purchased at high prices which aggregate four years' normal output. We have developed our productive capacity in this country up to a point where in four months we can produce what is necessary for home consumption, and in order to utilize fully the plant capacity and labor available we must find an output in foreign markets for the additional eight months' output. We cannot do this without a merchant marine, and yet the merchant marine which we are now building is costing $200 per dead-weight ton, as compared with a cost of $50 to $70 per dead-weight ton in other countries. Our seamen's laws require American crews, which means operating costs many times that of other nations. In order to maintain itself, a merchant marine must be able to justify itself from an economic standpoint, and we shall be unable to do this without material liquidation in the first cost of the ships and a revision of the existing seamen's laws.

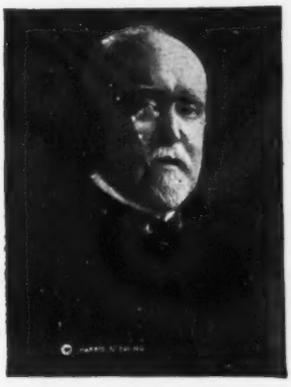
The government has purchased the entire stock of raw wool in this country at from 60 to 70 per cent higher prices than are now being quoted. Moreover, the government is under moral obligation to purchase the entire wheat crop, which is the largest in the history of our country, at $2.25 per bushel, whereas foreign wheat, of which there seems to be a considerable supply, is being now quoted at $1.40 per bushel. All of these items mean heavy losses which must be assumed by the government and which must finally be absorbed by taxation.

In the field of electrical apparatus no reduction in prices can be made until there is some change in the rate of wages paid and the cost of raw materials used. It is exceedingly doubtful whether any material reduction in these factors can be expected for some time. Since 1914 the price of electrical apparatus has increased approximately 70 per cent, whereas the rate of wage and the cost of the principal raw materials used has practically doubled. Labor has decreased,

rather than increased, in efficiency during the period of the war. The labor turnover has increased very materially. Provided that business is maintained, the present labor turnover will easily permit each organization to absorb the men who were drafted into the service, which will automatically eliminate some of the present shifting, inefficient labor. Any change in the rates of wages will be a last resort and can only be equitably effected with material reductions in the cost of living. Every effort will doubtless first be made to offset present wages by increased efficiency.

The price of copper, one of the principal raw materials, has been under government control, and has not decreased with the release of that control.* The iron products used have also been largely under government control, and it is only necessary to remember where prices were before government control to judge whether with business above normal for the year 1919 any reduction in the cost of raw materials can be expected. Many projects are at the present time being held off for lower prices, and in certain fields of manufacture lower prices can certainly be expected where there has been inflation during the period of the war out of proportion with the increased cost. In the case of electrical apparatus, however, no reduction can be expected until there are material reductions in the cost of raw materials, but for the reasons stated this seems exceedingly doubtful.

Electric Propulsion on the New Mexico



REAR ADMIRAL GRIFFIN

Rear Admiral Griffin of the Navy Department Says that the New System of Driving Warships Is Adopted as a National Policy, and that Great Britain and France Will Probably Follow the American Lead

BY WINGROVE BATHON
Washington Representative ELECTRICAL WORLD

INTERESTING details concerning the system of electrical propulsion in use on the new battleship New Mexico have been furnished to the writer by Rear Admiral R. S. Griffin, chief of the Bureau of Steam Engineering of the United States Navy, in a recent interview in Washington, and as a result of the standardization trials of the warship, held off Rockland Breakwater late in December, Admiral Griffin predicts that the navies of Great Britain and France will follow the American lead in propulsion in future warships. Admiral Griffin also formally announced in this interview that ten other capital ships of the United States Navy now appropriated for will be electrically propelled.

"Great Britain and France," Admiral Griffin said, "have not yet tried electric propulsion in their navies, but when Sir Eric Geddes and his party, representing the British Admiralty, were here recently they were very much interested in the New Mexico, and after they saw the ship in operation they were much impressed, although the British are conservative and have always been cautious in taking up new ideas. The French have been much interested too. I do not, of course, know the naval policies of those countries, but I do not see how any one can fail to realize the great advantages electric propulsion of warships offers, and I predict that both countries will adopt the new system."

In the annual report of the Secretary of the Navy, recently quoted in the ELECTRICAL WORLD, it was stated that it was to the vision and wisdom of Admiral Griffin and his assistants that the world owes "this successful revolution in the propulsion of the biggest fighting ships." In Admiral Griffin's mind, and in the minds of his assistants, following the building and operation of the electrically propelled collier Jupiter, there has never been the slightest doubt as to the success of electrically propelled fighting ships. Questions of speed and maneuvering enter into the building of fighting ships which do not enter into the building and operation of colliers, and on the question of speed alone, when the New Mexico was put through her standardization trials off Rockland Breakwater, Dec. 18, 1918, she made 21.33 knots, although it was only guaranteed that she should made 21 knots. In Admiral Griffin's office it was afterward naïvely remarked:

"Every one expected the ship to make more speed than required. If she had not made more speed than required, she would have been a failure."

As a result of the success of the New Mexico, there are to be, now appropriated for and without taking future naval programs into account, six battleships and five battle cruisers equipped for electrical drive. The battleships are to have a guaranteed speed of 21 knots and the battle cruisers a speed of 35 knots. Both classes will do more, it is expected, than required. Including

*Since this was written by Mr. Collens the Copper Export Association, Inc., has fixed the price of 23 cents a pound for export copper, from Jan. 1, 1919.—Eds.

the New Mexico and excluding her sister ship, the Idaho, which is not to be electrically propelled, so as to offer opportunity for comparisons, the following are to be the new electrically propelled battleships: New Mexico, built at the New York Navy Yard; Tennessee, building at the New York Navy Yard; California, building at the Mare Island Navy Yard; Colorado, building at the yards of the New York Shipbuilding Corporation; Washington, building at the same yards; Maryland, building at the yards of the Newport News Shipbuilding & Dry Dock Company. The electrically propelled battle cruisers and their builders are: Lexington, Fore River Shipbuilding Corporation; Constellation, Newport News Shipbuilding & Dry Dock Company; Ranger, the same yards; Saratoga, New York Shipbuilding Corporation, and Constitution, Philadelphia Navy Yard.

MACHINERY TO BE MODEL FOR OTHER SHIPS

In general it may be stated that the machinery of the New Mexico will be used as the model for the machinery for the other ships. The New Mexico has two turbo-generators, good for 11,000 kw. each, and four 7000-hp. induction motors. These motors are arranged for pole-changing, with a twenty-four-pole arrangement at high speed and thirty-six for anything below 15 knots. The generators are arranged for 4442 volts when running with both generators and 3000 volts when running with one generator. A double-throw switch is provided so that a high-voltage or low-voltage connection can be made depending or whether two or four motors are being operated. The generators are two-phase, high voltage being obtained with a square arrangement of winding and low voltage with a parallel or diametrical connection. The latter gives increased current rating of the generator when running four motors. When the ship is running with one generator feeding all four motors at low speed high voltage is not wanted; but, on the other hand, when each of the four motors is receiving current from the same generator a large current capacity is required, and this condition is met by the described change in the windings, which arrangement is said to be ideal, because under it there is given a desired reduction of voltage as well as increased current capacity at the same time.

The main turbo-generator sets are installed in rooms outboard of and alongside of the center engine room. The two outboard motors are in rooms just abaft the generator rooms. The two inboard motors are in the center engine room, just abaft the switchboard.

Most of the switching is mounted on one structure in the center engine room. The exceptions are the generator disconnecting switches and the generator field switches. The generator disconnecting switches are installed on the two bulkheads of the center engine room, and the generator field switches are installed on the direct-current exciter switchboard, also in the center engine room.

The switches on the structure in the center engine room are the pole-changing switches for the motors, the reversing switches for the motors and the disconnecting switches for the motors. The disconnecting switches are simple knife switches at the top of the board and are not intended to open live circuits. They are only there in order to cut out a motor in case the room should become flooded from torpedo or mine attack. The generator field is always opened and the current allowed to die out before opening any of these switches. The bus-tie switch, which allows one generator to operate all four motors, is the same type of switch and is installed at the top of the switching structure in the center. The pole changing and reversing switches and the field and speed and steam-limiting switches are all in front of the switchboard structure and constitute the operating gear.

The reversing and pole-changing switches are capable of opening live circuits, but, owing to the method of operation, they are normally opened and closed on circuits with very little current in them. The reason for this is that before any switches are moved the field of the main generator is opened, thus allowing the current to drop in the main circuits, and none of the operating switches are moved until the current in the system has dropped to a predetermined amount which is determined by an underload current relay.

The speed adjustment, aside from changing from low speed to high speed, which is accomplished by pole changing, is effected by regulating the speed of the turbine, or, in other words, by changing the frequency of the generator. When it is desired to vary this speed the setting of the governor is altered by the speed lever on the front of the switchboard. For each setting of the governor there is a corresponding setting of the steam-limit lever, and this limits the amount of steam that the turbine can take for any setting of the governor. This steam-limit lever is necessary for use in connection with turning the ship. When the ship turns, if the governor were allowed to keep the turbine running at the same speed, an enormous increase in power would be required; but the steam-limit lever will allow only a certain maximum amount of steam to go into the turbine, and after this amount has been reached further demands for power are met by the turbine automatically slowing down.

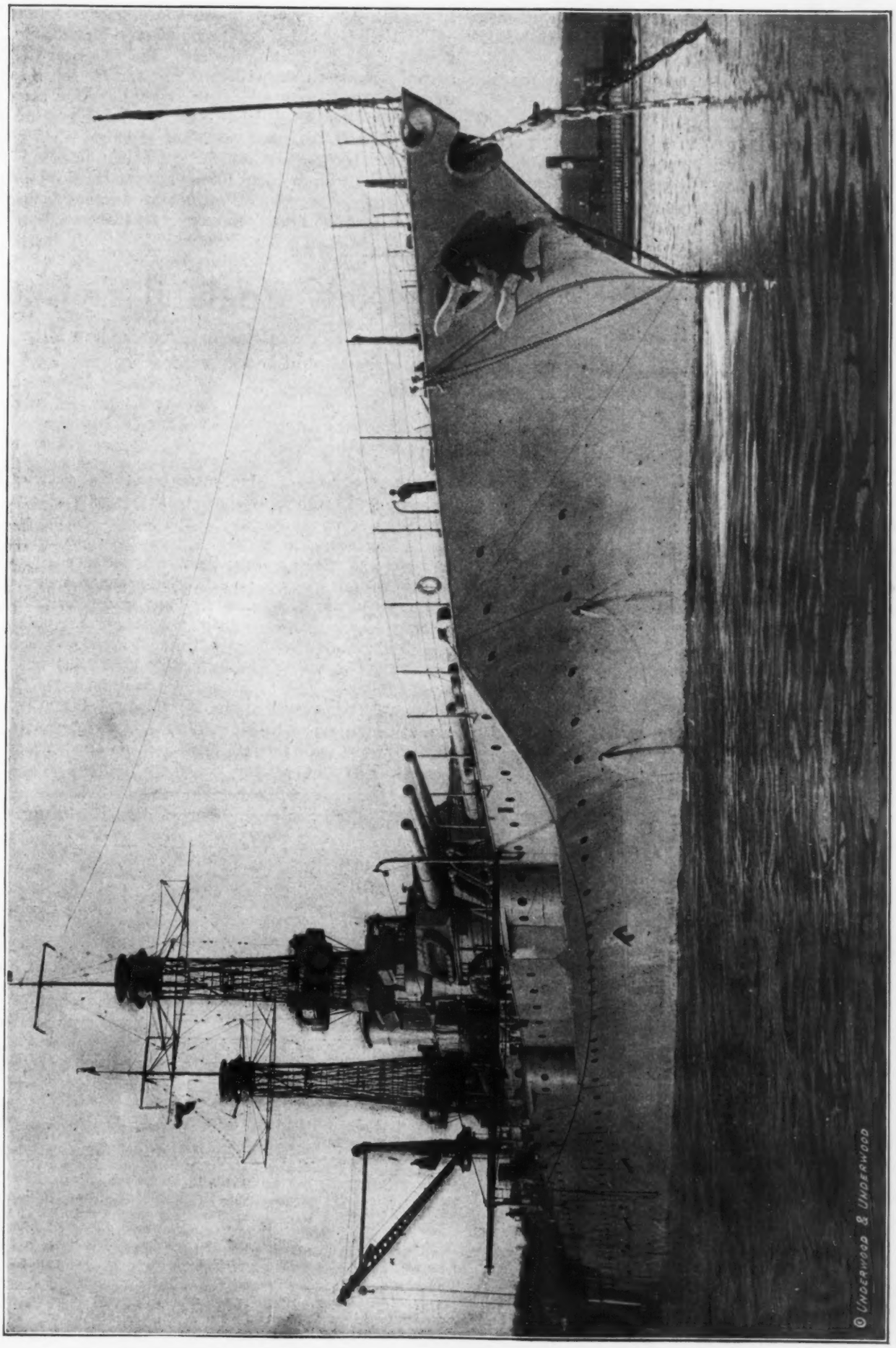
Excitation for the main generator field is furnished by two 300-kw. non-condensing sets which exhaust into either the fifth or the eighth stage of the main turbines, with a by-pass to the main condenser for use in starting up, or when all power has been taken off the main turbine. This field current is supplied through a small booster set which is used to vary the voltage of the 300-kw. machines, thus giving the desired current in the generator field.

The remaining power of the 300-kw. machines is used for running the main engine auxiliaries and ventilator blowers for the main motors. All of the main engine auxiliaries and the 300-kw. exciters are in the center engine room.

The electrical equipment of the New Mexico was manufactured by the General Electric Company, which proudly terms the war vessel its "baby ship."

TEN MORE CAPITAL SHIPS TO BE EQUIPPED

The success of the New Mexico's machinery, and the fact that electrical propulsion machinery for ten other capital ships is now about to be built under the direction of the Bureau of Steam Engineering, has given rise in Washington to the idea that there should perhaps be created a separate bureau in the Navy De-



THE ELECTRICALLY PROPELLED BATTLESHIP NEW MEXICO, NOW LYING AT ANCHOR IN THE HUDSON RIVER, OFF NEW YORK

partment to deal with electrical matters, or, if not, that the word "electrical" should be incorporated in the title of the Bureau of Steam Engineering.

Approximately $20,000,000 was expended by the bureau for electrical purposes during the past year, and no annual report of any bureau or department in Washington contains as many details concerning electrical machinery, material and personnel as that of Admiral Griffin. The field of expenditure and invention under Admiral Griffin has comprised generators, lighting systems, telephones, searchlights, electrical installations in submarines and naval aircraft and the development of all electrical anti-submarine and anti-aircraft devices, including detection devices. The electrical fire-control systems on all battleships and smaller ships, as well as electrical communication systems for the service of guns on ships, have been remodeled and improved during the past year, and Admiral Griffin's bureau has been responsible for more than 4000 radio installations. More than 100 graduates in electrical engineering were enrolled under the bureau during the past year and have been serving as reserve officers.

Outlook for Jobbing in New England

Prospects Give Reason for Optimism—Buying Power of the General Public Greater than Ultra-Conservatives Appreciate, and Civilian Business Should Increase Steadily as Government Consumption Declines

BY HANSON M. SAVAGE
Wetmore-Savage Company, Boston, Mass.

THE outlook for the new year in New England jobbing circles gives reason for optimism. With the war behind us, the manufacturers in better condition than for many months to meet the requirements of the civilian market, and the jobbers well prepared to handle a large business on the basis of immediate deliveries in many lines of material, trade ought to do well in 1919. Stocks of lamps, motors, wiring material and electrical conveniences are in excellent shape, and the buying power of the general public is greater than many ultra-conservatives appreciate.

The expectation is that the amount of government business placed in the hands of the jobbers will fall off rapidly this year and that civilian business will increase month by month. Whether prices fall materially or not, a large trade must be handled to supply the needs of the 110,000,000 people of this country, including the extension of electrical service in both old and new fields. Whether prices change much or not, jobbers will be in the market in the near future to replenish stocks at present short or to replace material which will soon be called into use by the demand for increased electrical service.

Active canvassing of the New England territory is under way (some of the more progressive houses have kept their field forces at work all through the war period), and intensive solicitation of new business is the order of the day. It does not seem likely that the central stations long can defer the extension of their lines into many hitherto unoccupied fields. Deliveries are showing considerable improvement as the new year begins, and it is expected that this favorable condition will continue, barring occasional delays in shipment and transit due to winter interruptions of rail or water service. I have already referred to the fact that the manufacturers are in excellent shape to meet domestic orders. The contractors are being called upon more and more to prepare estimates for construction work, which is a good sign.

While high prices of labor and material tend to hold back building construction at this time, it looks as though there would be a gradual increase in such work even in the face of high prices, and the electrical industry will accordingly share in the benefits of this.

A word as to the services of the jobbers during the war. The electrical supply jobbers have performed patriotic and efficient work; their coöperation has been most helpful in speeding up deliveries of supplies needed in the production of war material and in observing the priority requirements. Without the jobbers' help many war plants would have been badly handicapped in reaching a mass production basis, and it is not too much to say that the jobber was an important factor in the successful termination of the war in 1918. Our men are being welcomed back from the service into an industry bright with promise and based on fundamental necessities of civilization.

A Well-Conceived Utility Office Building

Architecturally harmonious with its surroundings, the recently completed general office building of the New England Power Company, Worcester, Mass., occupies a site on a fine old residential street within a couple of blocks of the business district. The new home of the company is 70 ft. long by 45 ft. wide, comprises two stories and a basement and houses about seventy persons. It includes offices for the general manager, engineering and operating officials, a drafting room, blue-print room, meter laboratory, and quarters for the accounting, legal and other departments.

New Multiplex System of Telephony

Developed After Several Years of Effort, It Will Increase Manyfold the Message-Carrying Capacity of Long-Distance Telephone and Telegraph Wires—Suggestive Value of Earlier Undertakings in This Field

A NEW multiplex system which marks an epoch in the development of long-distance telephony and telegraphy is the most recent practical application of the work of the technical staff of the Bell system, and was announced on Dec. 11, 1918, by Theodore N. Vail, president of the American Telephone & Telegraph Company.

The new system of multiplex telephony and telegraphy has been invented and developed after several years of intense effort, and by its use it is now possible to increase manyfold the message-carrying capacity of the long telephone and telegraph wires. The system has been in actual use between Baltimore and Pittsburgh for more than two months now with entirely satisfactory results.

On Dec. 9 Mr. Vail, accompanied by a party of distinguished government and telephone and telegraph officials, made an inspection of the system at Baltimore and a test of the service provided by it between Baltimore and Pittsburgh. The party was unanimous in its appreciation of the skill which had been shown in developing the new system and of the success of its operation.

Permits Five Conversations on One Circuit

The new multiplex system permits four telephone conversations to be carried on simultaneously over one pair of wires in addition to the telephone conversation provided by the ordinary methods. That means that over a single circuit a total of five telephone conversations are simultaneously transmitted, and in each the service is as good as if the circuit was carrying, in the ordinary way, a single conversation.

A number of years ago the Bell engineers developed the "phantom-circuit" arrangement by which telephone circuits are obtained from two pairs of wires. This is an improvement and has been extensively used, but heretofore it has been impossible to carry over a single pair of wires more than one telephone conversation.

Now it is possible by the multiplex method to utilize a single pair of wires for five conversations, while two pairs of wires, which heretofore had a maximum of three conversations with the aid of the "phantom," may now be multiplexed to carry ten simultaneous conversations. This amounts to an increase of more than threefold in the telephonic carrying capacity of the wires as compared with the best methods previously known to the art, and an increase of fivefold in the capacity under conditions where the phantom circuit just alluded to is not employed.

The new multiplex system makes use of alternating currents whose frequencies occupy a range between the frequencies of the ordinary telephone currents, which are those of the human voice, and the lowest frequencies which are used in wireless communication. This frequency range has not heretofore been commercially used. It is interesting to note that under favorable conditions the whole range is audible to many and the lower part of the range is audible to any one with normal hearing. It is found that frequencies within this range are high enough to be used as "carriers" of ordinary telephone currents and yet with proper arrangements can be transmitted over long telephone lines without the large transmission losses and large interference between circuits which would be brought in by higher frequencies.

Each additional circuit in the new system makes use of some frequency within this range. At the sending end of each circuit the ordinary telephone currents are made to modulate this "carrier" frequency so that the amount of carrier frequency sent out on the line varies with the amplitude of the ordinary telephone currents. At the receiving end the carrier current is put into a demodulating circuit which then gives out the original telephone current.

The different circuits are kept separate at each end by inserting in each circuit a combination of impedances which make up an electrical "filter." This transmits the range of frequencies peculiar to that circuit and stops all other frequencies. An important difference should be noted here between this system and wireless systems in that in wireless working it has been generally sufficient to send and receive in "tuned" circuits. In the multiplex system, however, tuned circuits would not be sufficient since each telephone channel occupies a range of frequencies of about 2500 cycles and any circuit tuned to these comparatively low frequencies would be too selective to receive such a range in the proper manner.

Vacuum tubes are used in the modulating and demodulating circuits and are also used as amplifiers in the transmitting and receiving branches and at intermediate points along the line where necessary to prevent the currents from becoming too highly attenuated.

Illustration of the Underlying Principle

The underlying principle may be illustrated by considering a composite photograph of five individuals. Given such a composite photograph of the ordinary kind, it would obviously be impossible to derive from it the picture of each of the five individuals going to make it up. If, however, the composite photograph had been made up in five different colors, the picture of each individual being in a different color—say, one red, one blue, one green, one yellow and one violet—it would then be possible by looking at the picture through colored glasses to see any one picture separate from the others. If red glasses were used, the picture printed in red only would be seen, if blue glasses the picture in blue, etc., although when looking at it in the ordinary way all of the pictures would be seen together and only the combination would appear. As the tint of each picture serves as a means of differentiating it from the others, so the frequency of the carrier currents serves to dif-

ferentiate each of the conversations in the new telephone multiplex.

Sensational results have also been attained in telegraphy by the new multiplex system. A single pair of wires combined into a metallic circuit of the type used for telephone working will, by the application of the Bell system's new apparatus and methods, have an enormously increased capacity for transmitting telegraph messages.

As applied to high-speed printer systems the engineers find they can do eight times as much as is now done, and as applied to the ordinary duplex telegraph circuit in general use, they can do ten times as much. These increased results are attained without in any way impairing the telegraph working.

Moreover, the nature of the developments permits the same wires to be used partly for telephone and partly for telegraph purposes. This means that a pair of wires is available either for five simultaneous telephone conversations or for forty simultaneous telegraph messages, or partly for one and partly for the other.

MAJOR-GENERAL SQUIER

The technical staff of the Bell system has acted as an organization in working out these developments, which are the outgrowth consequently of combined inventive and engineering skill of hundreds of scientific men. It is impossible to name any one man who is even entitled to the major part of the credit for the work. However, without detracting from the credit due to any one, there are a few whose contributions are more distinctive. They are O. B. Blackwell, G. A. Campbell, H. S. Osborne, J. R. Carson, Lloyd Espenschied, H. A. Affel and John Davidson, Jr., of the engineering department of the American Telephone & Telegraph Company, and E. H. Colpitts, H. D. Arnold, B. W. Kendall, R. A. Heising, H. J. Vennes, E. O. Scriven and H. F. Kortheuer of the engineering department of the Western Electric Company, the manufacturing division of the Bell system.

The work was under the executive direction of Col. John J. Carty, chief engineer, and Bancroft Gherardi, acting chief engineer of the American Telephone & Telegraph Company, and Frank B. Jewett, chief engineer of the Western Electric Company.

There have been numerous attempts by inventors, scientists and engineers from the earliest days of both the telegraph and the telephone to develop methods for the multiplex transmission of messages. Dr. Alexander Graham Bell was working on the problem of multiplex telegraphy when he had his first conception of the structure of the original telephone. It is significant that the Bell system organization, which has been and is working continuously to perfect the telephone and extend its usefulness, has accomplished not only multiplex telephony but multiplex telegraphy, Dr. Bell's unsolved problem of forty years ago.

BENEFIT FROM EARLIER INVESTIGATIONS

Notwithstanding the fact that there were no conclusively practical results from the early efforts in this direction, it is nevertheless true that some of the undertakings of the earlier workers in this field have been of suggestive value at least in the working out of the problem. As an instance, there is a suggestion made by Major General George O. Squier, Chief Signal Officer of the United States Army, about ten years ago which attracted very general attention. Likewise, Dr. Lee De Forest, working in entirely different fields and with a different objective, a number of years ago invented a wireless device known as the audion, which by the improvements and adaptation of the Bell system engineers has been made an important part of the system.

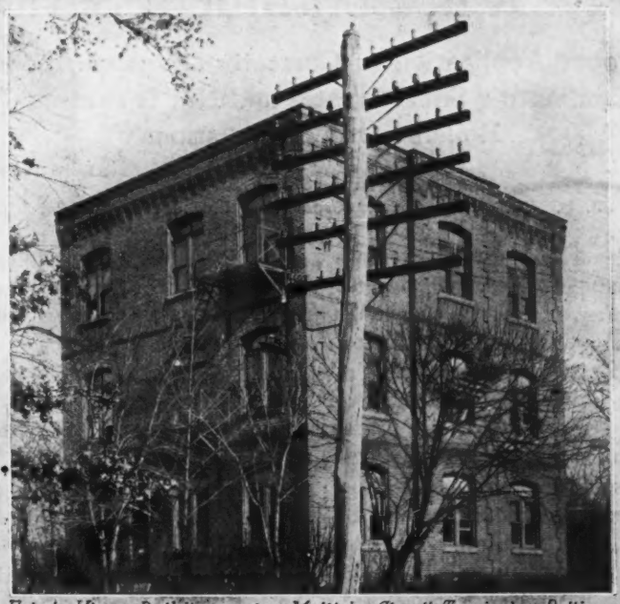
While the new multiplex system is physically adaptable to short lines, from the nature of the apparatus and methods employed it is not practically advantageous on lines of much less than 100 miles. On longer lines its application will be extended immediately, but its introduction must necessarily be gradual on account of the nature of the apparatus required and the rearrangement and adaptation of the lines themselves and their associated apparatus to the new methods of working.

The new multiplex system as it is now applied to the telephone is a means of increasing or multiplying the transmitting capacity of long lines, requiring no change in the subscriber's telephone or in the terminal switchboard operation. It is quite as applicable to transcontinental lines as to any other long-distance service.

I AM quite certain that it would be improper for America even to consider the proposition of contributing to the world police a number of units smaller than that contributed by the greatest other power. It seems to me that this is obviously the American duty and that the other nations of the world would be justified in regarding us as shirkers if we failed to accept the burden of it cheerfully and turn to the performance of it with an unexampled earnestness and high efficiency. It would be contrary to all our traditions and all our ideals to assume that in the planning of a new and mighty navy America could be animated either by fear or by the intention of aggression.—*Secretary of the Navy Daniels.*

Left to Right Standing–

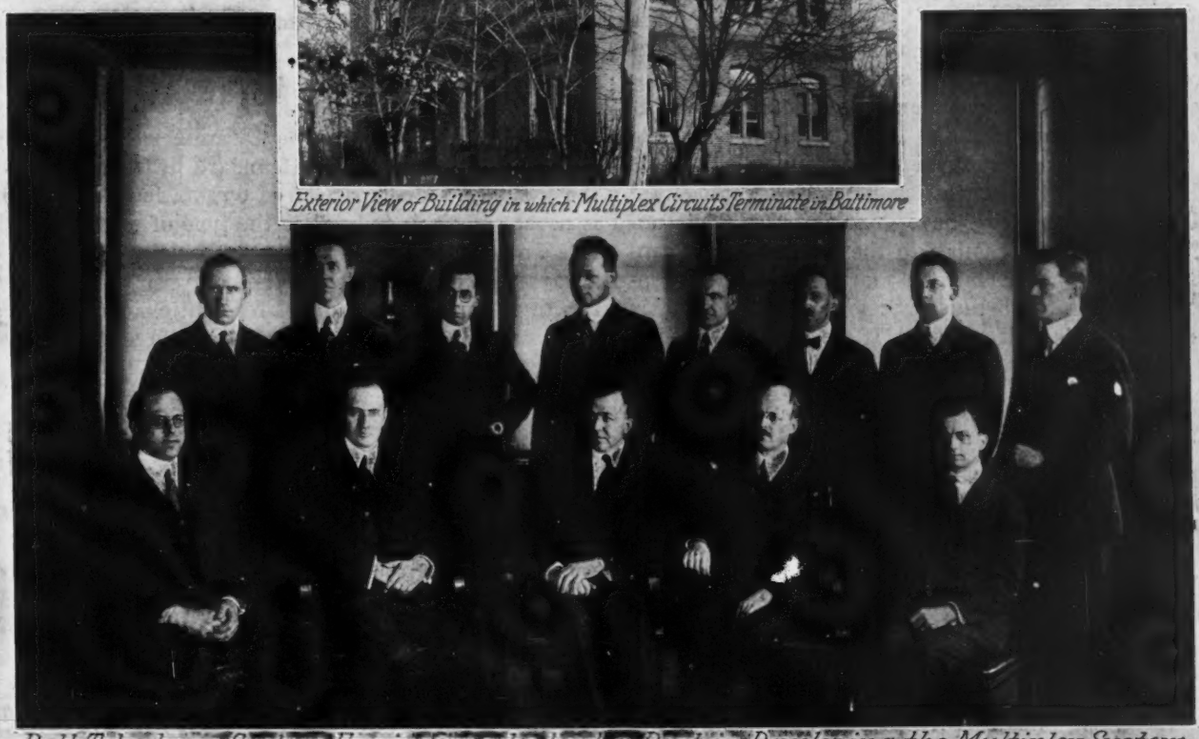
H.J. Vennes,
E.O. Sciven,
Lloyd Espenshied,
H.A. Affel,
H.F. Kortheuer,
J.R. Carson,
R.A. Heising,
John Davidson.



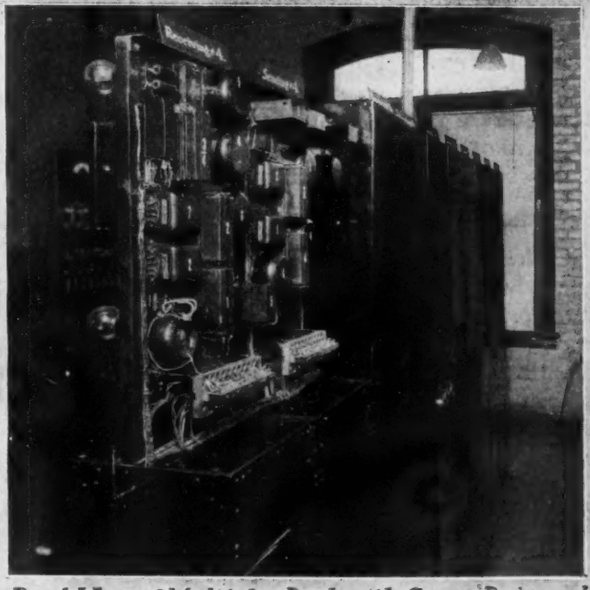
Exterior View of Building in which Multiplex Circuits Terminate in Baltimore

Left to Right Seated–

H.D. Arnold,
O.B. Blackwell,
E.H. Colpitts,
B.W. Kendall,
H.S. Osborne.



Bell Telephone System Engineers who had a Part in Developing the Multiplex System



Back View of Multiplex Rack with Covers Removed

General View of Multiplex Apparatus

Fuel Economy Will Continue a Serious Problem

Can Be Improved by Proper Application of Correctly Designed Apparatus, Maintaining High Vacuum, Eliminating Small Wastes and Not Operating Too Many Boilers—Other Suggestions

BY W. A. SHOUDY
J. G. White Engineering Corporation, Mechanical Division

ONE of the serious problems confronting the central stations in this period of readjustment is that of fuel economy. The most optimistic of prophets do not expect to see in the near future a reduction of fuel cost that will be sufficiently great to bring the cost of coal or oil even within hailing distance of prewar prices. That there may be some reduction is possible, since the excessive demands upon the fuel resources of the country will be somewhat lessened by the reduction of strictly war demands and by the reopening of European mines. But the labor of mining and the cost of freight will probably never return to the old standards; hence the conclusion must be accepted that the days of low fuel cost have gone forever. This unusual cost is serious enough to the manufacturer generating his own power, but it is more serious to the central-station operator because the major portion of his production cost is that of fuel. If, therefore, power is to be sold at low rates, the fuel cost must be reduced or the margin of profit wiped out.

FUEL WASTE A NATIONAL CRIME

The small attention that has been paid to fuel economy in the past years, with the resulting excessive waste of fuel, has been a national crime. Fortunately the central station carries less blame than do the other users. Such attention as has been paid to the subject has been principally in this industry—first, because fuel cost has been so large an item in the total, and, second, because those in charge have been more conversant with the subject and therefore could give it more careful attention. The manufacturer has steadily refused to consider the subject seriously and has been content so long as the cost did not rise and so long as production was not lessened. The design of his power plant has usually been based upon minimum first cost, and his operating engineers have been chosen as if they were merely skilled laborers and often paid less. He has seldom encouraged them in the study of improvement and has spent money for replacements only as a last resort, and then grudgingly. In short, he has considered fuel cost a necessary evil of a fixed magnitude, and it has seldom entered his head that this evil might be somewhat mitigated by intelligent attention.

To a limited extent this is also true of some central stations. Fuel has been cheap and the price stationary. An increase in the station output or an improved load factor has resulted in a lower cost per kw.-hr. Because this slight change has been in the right direction the management has assumed that no further attention was necessary and has not been willing to go to the expense necessary for establishing a department in charge of economy until increased cost has forced it to do so. It has lost sight of the fact that the cost of such a department is fully justified even though the station has been generally well managed, because the highest economy can never be reached without such help and the fact that such a department exists acts as a stimulus to the operating force. Stations of very small capacity can seldom justify a department for each station, but by grouping a number of small stations one department can usually effect great economies. When such small units are separately owned and operated the employment of a consulting engineer is the equivalent of establishing an economy department.

Possibly this false attitude toward economy exists because there is generally no standard by which to judge the economy. A comparison of one station with another is never satisfactory because the type of equipment differs and load conditions vary so widely that there is always the chance to excuse the poor economy by pointing to the unusually bad load conditions or inefficient equipment. In fact, some stations would soon lose their reputation for economy if it were known how far from their true standard they had strayed.

The first step toward economy is to use correctly designed apparatus, but even with this the degree of economy obtainable is determined by the care with which the equipment is applied. Once installed the apparatus will give the best results only if the following rules are observed:

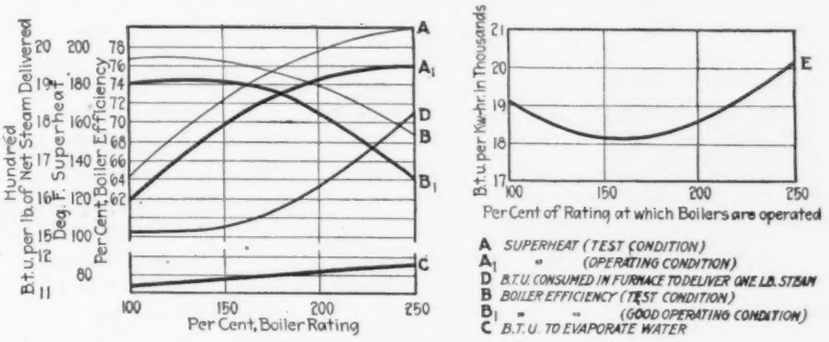
1. Maintain as high a vacuum as conditions permit.
2. Carry no more boilers on the line than continuity of service demands.
3. Watch for the small, generally neglected wastes.

The three foregoing rules are much more important than they may appear on first reading because for the efforts exerted the benefits are largest and because work along these lines may be started before standards of economy are set. Furthermore, observance of the first two rules can be easily checked by the management. To reach the highest pinnacle of economy some goal or standard of economy must be set toward which to work and to serve as a gage of results.

RELATION OF FUEL ECONOMY TO SUCCESSIVE PROCESSES

Considering the three steps in the generation of electric power by steam—(1) generation of steam, (2) transformation of the steam energy into mechanical energy, and (3) conversion of the mechanical energy into electrical—there is little opportunity of effecting economies in the third step in an existing station. This is so because the efficiency of electrical generators is not greatly affected by changes in operating conditions. In the second step, however, careless operation may seriously affect economy, and in the first the opportunities for waste are so vast that they must be watched with the greatest care. The electrical end may therefore be passed by in this discussion and attention confined to the turbine and boiler rooms.

In the turbine room there is comparatively little that can be done to improve economy except to keep the apparatus in repair and properly distribute the station load over the several units. If these units and their auxiliaries are in good condition and the load properly distributed, there remain but three items that may affect the economy in this depatment, viz., steam pressure, superheat and vacuum.



FIGS. 1 AND 2—RELATIONS BETWEEN SUPERHEAT, BOILER EFFICIENCY, B.T.U.'S PER POUND OF STEAM AND PER KILOWATT-HOUR AND THE PERCENTAGE OF RATING AT WHICH BOILER IS OPERATED

The steam pressure seldom needs special attention because the operators have become accustomed to keep a constant watch on the pressure gage and permanent records can be easily kept with a simple recording gage. It is often given too much attention since such variations as are likely to occur in a modern plant are so small as to be negligible. So long as the minimum pressure is that for which the turbines are designed, a variation of 10 lb. or 15 lb. will not affect the economy as much as a variation of 0.25 in. (6 mm.) in the vacuum. However, it is advisable to give the steam pressure some attention because of the psychological effect. Carelessness in this respect may affect the whole morale of the operating force.

In existing turbine stations the highest superheat that is economically obtainable from the equipment is desirable inasmuch as it has a direct effect on the steam consumption of the turbine and steam-driven auxiliaries. Unfortunately the degree of superheat is not readily controlled because American superheaters are built into the boilers and are not independently fired. Hence the degree of superheat varies with the rate of forcing the boilers. If the superheaters are clean and in good repair, about the only means of varying superheat is by varying the boiler loading. To maintain a constant superheat the boilers must be operated at a fixed rating. Since the station load varies widely, this can only be done by cutting boilers on and off the line as the load varies. However, an increase in superheat is not an unadulterated benefit because the increased temperature is obtained at the cost of a reduction in boiler efficiency due to operating at high overloads. The slight saving arising from a constant degree of superheat is offset by the necessity of carrying banked boilers and the concomitant loss of fuel through banking.

When the time for great refinement has been reached it may be advisable to operate the majority of boilers at a fixed rating, the balance being used to carry the fluctuations of the station load. There may also be the possibility of automatically bypassing some of the furnace gases so the superheat is maintained constant. This can only be determined by careful investigation of each station. Such an investigation should also include a study of the effect of high ratings upon the life of the boiler and setting. Unless the feed water is pure, the setting properly designed and the draft condition correct, the increased maintenance charges are likely more than to offset the saving due to higher superheat obtained by operating at higher ratings. This point is illustrated graphically in Fig. 1, the data for which were obtained from tests on a 500-hp. water-tube boiler equipped with abundant superheating surface and operated under good conditions. The boiler is equipped with a six-retort underfeed stoker using coal at about 13,500 B.t.u. In determining these figures allowance has been made for the steam required to drive the stoker and blower, assuming that each boiler has its own stoker and blower engines. It will be noted that curve C rises slowly with the increase of boiler rating because the resulting higher superheat requires slightly more heat per pound to evaporate the water and supply the superheat. Curve D rises very rapidly after 175 per cent of rating because it includes boiler efficiency, which drops rapidly beyond this.

The effect of increase of superheat on the economy of a 10,000-kw. turbine operating at three-quarters load is illustrated in Fig. 3. The increased heat input necessary for higher superheat is offset by the decreased quantity of steam required to produce a kilowatt-hour. However, if the increased superheat is obtained by forcing boilers, there is a point reached when further superheat shows no gain but rather a loss because of the lower boiler efficiency. This is shown by Fig. 2, which is a graph of the heat that must be removed from the

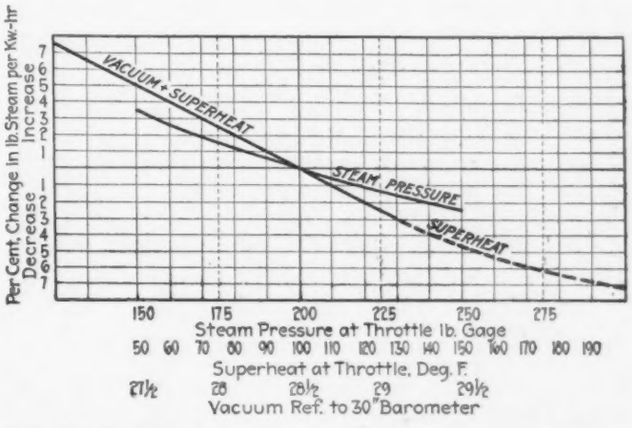


FIG. 3—CHANGE OF TURBINE WATER RATE WITH VARIATIONS IN STEAM PRESSURE, SUPERHEAT, OR VACUUM

coal to deliver one kilowatt-hour when the boilers are operated at various ratings. The variation is so small between 125 per cent and 175 per cent of rating as to be negligible. The usual station maximum is of such short duration that the lower economy at such times cannot affect the gross economy as much as will the

waste of fuel during banking hours if additional boilers are carried to avoid the lowered economy at the peak.

While the figures referred to are for specific equipment, they may be considered typical. If fewer retorts or a different type of stoker were used, the results would be similar but the limits different.

The effect of variation in steam pressure, superheat and vacuum on the steam consumption of a 10,000-kw. turbine at three-quarters load is shown in Fig. 3. At other loadings the results are similar. It shows that an increase in vacuum of ¼ in. (6 mm.) results in as great a decrease in steam consumption as is obtained by 24 lb. (1.7 kg.) increase in pressure or by a 13-deg. Fahr. (7 deg. C.) increase in superheat. The influence on fuel consumption is even greater because the increase in steam pressure or superheat is only obtained by an increase in fuel consumption to produce the higher temperature or pressure. This is the reason for placing high vacuum as one of the three requirements necessary for fuel economy.

The statement is sometimes made that it does not pay to operate a turbine at a higher vacuum than that for which it is designed. However, these curves, which are based on the performance of a turbine designed for 28½ in. (723 mm.) vacuum, indicate that a higher vacuum gives an attractive economy. There are times when purchasing new equipment when the higher cost of a high-vacuum condenser is not justified by the resulting fuel economy, but the highest vacuum obtainable with given equipment is always justifiable. The care of the vacuum is therefore the principal point to be observed in the turbine room.

The number of boilers carried on the line is the next important point. The influence of forcing boilers on the economy is illustrated in Figs. 1 and 2. If only sufficient boilers are operated to carry the peak (with a reasonable margin of safety in case of the loss of one boiler by accident before and after the peak period), they will operate in the region of their highest economy and at low loads not much below. If more boilers are carried, the number of boilers to be banked will be increased and the additional coal burned in banking hours will be a dead loss.

The result of attention to the first two requirements stated at the outset may be entirely wiped out if the third is forgotten. The small usually neglected wastes are the worst enemies of economy. Carelessness in these things soon breeds carelessness throughout the entire station, and the operators can never be expected to do their best unless the importance of small things is impressed upon them. There is nothing too small to merit attention in the central station, and until this attitude is insisted upon efforts at economy are wasted. It is impossible to catalog all items which should be watched. However, among them are leaky blow-off cocks, traps, joints and valves, carelessly banked and carelessly cleaned fires, unnecessary blowing of safety valves, etc.

The connecting link between the boiler and turbine rooms is the auxiliaries. These do not admit of much alteration in existing plants; the most that can be done is to keep them in repair, operate them as they are designed to be, and never to use two when one is enough. First look at the feed-water temperature, then look at the exhaust outlet to the atmosphere. If the feed-water temperature is low and there is plenty of exhaust, get after the feed-water heater. If there is still an excess of exhaust, reduce it if possible; if not, make the best of a badly designed station.

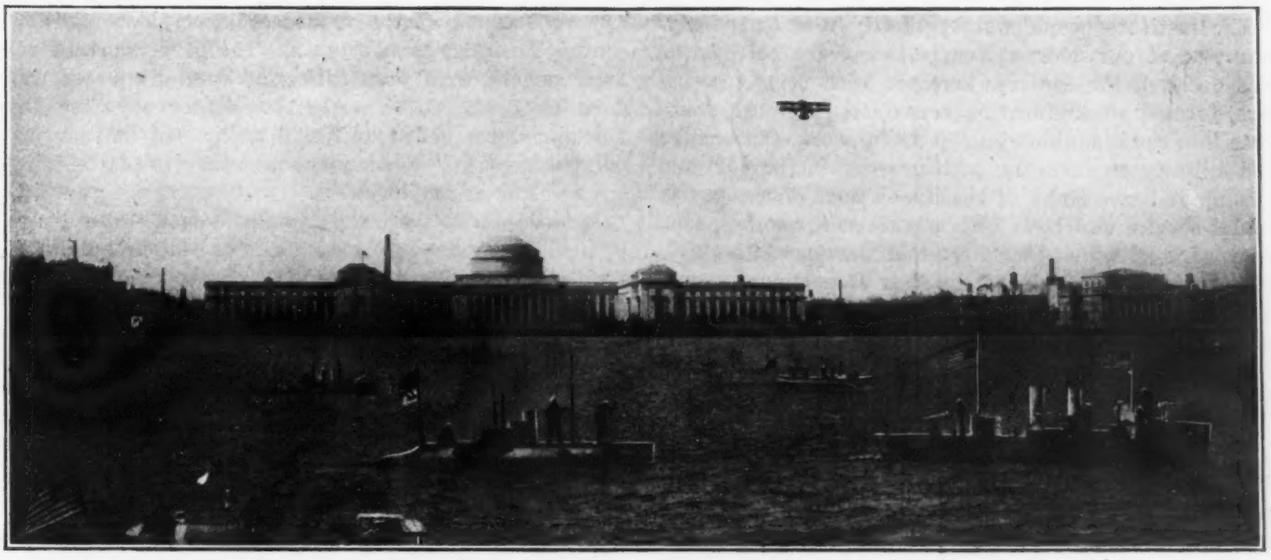
The bulk of the work has now been done, and the time for testing instruments has arrived. The number that can be justified depends upon the size of the plant. There are some instruments that should be in all stations: A vacuum gage, with barometer if possible, a feed-water meter, a feed-water thermometer and some means of recording the quantity of fuel used. Nothing can be done without these. Other instruments should be added only when they will receive attention. A high-grade efficiency instrument out of order for some days will destroy the operators' confidence so completely that its usefulness is lost for perhaps months. It seems best therefore to add instruments only as rapidly as the crew can be trained to use them with complete confidence.

The task now becomes that of setting a standard for the station and this means a careful and extensive series of tests of nearly all apparatus and finally a series for the station as a unit. These need not be conducted with the accuracy required in the laboratory. Many approximations may be made if investigators are experienced. The testing corps need not be large and may be recruited from the other employees. The generating unit should be tested if possible. If an old unit, this is important; if a new one, the builder's guarantee may be used as a standard. The steam used by the various auxiliaries may be determined by measuring the water passing through the feed-water heater and its inlet temperatures and the exhaust steam calculated by the rise in the water temperatures. If there is an excess of auxiliary exhaust, a part may be diverted and measured at another time under similar conditions. The operating efficiency of the boilers may next be determined and compared with those that may be reasonably expected. These tests should show the efficiency during operating conditions and also should be carried over banking periods to determine the net efficiency including banking losses. With these three values—the steam used by the turbine, that for the auxiliaries and the over-all efficiency of the boilers—a standard fuel consumption may be set as a mark to be reached ultimately.

The series of tests made on the equipment will give sufficient data for setting a standard for each item in the weekly or monthly report. If these are plotted with the station records, the progress is not only recorded but the reasons for progress or the reverse are shown graphically.

With the standard set, the test then becomes one of unceasing "plugging" to determine better methods of operating and to train the operators into these methods. It is a hard task, but with a standard set progress can be shown and encouragement for better work obtained.

To the manager the writer would say, Don't hurry your economy man. Pick him with great care. He must know his job, he must like work and by all means be endowed with tact and diplomacy. Then turn him loose and let him alone for a few months, for he has a mass of detail ahead of him and must have time to work it out. If results come quickly, you may be sure that you have assigned him to a plant in poor condition. In a well-operated plant his results will show only after months of effort.



A Close-Up View of the S. A. T. C.

If We Are to Profit by the War Experience, This Is the Psychological Moment to Discuss and Formulate Rational Co-operation in Education Between Academic Institutions and Military Forces

BY JOHN RITCHIE, JR.

IT IS true that the Society for the Promotion of Engineering Education agreed at its recent meeting in Boston to consider only the larger questions of engineering education; still, there was very noticeable the undercurrent of question with reference to the Students' Army Training Corps and its effects on the colleges. This broke out at the last session when one college president plainly asked where his institution stood.

In two previous addresses President Maclaurin of the Massachusetts Institute of Technology had referred to the matter. One was at a students' mass meeting, when he used the phrase "enjoyed the S. A. T. C." in a sense that every one present understood and turned immediately to draw the lesson of how much better the men would feel for having patriotically done their bit. Later, before the meeting of the Association of American Universities, he stated directly that it was impossible to draw any conclusions from the brief trial. At the S. P. E. E. Dr. C. R. Mann referred to the difficulties, agreed with Dr. Maclaurin about the futility of trying to draw conclusions, and emphasized the splendid work of the great coöperative machine—the army. But at the same time there was hardly one of the professors present who had not reached his own conclusions with reference to the success of the short attempt at coöperative education between the army and the colleges.

At the Massachusetts Institute of Technology it is an open secret that there was much dissatisfaction, and even before the announcement that the S. A. T. C. was to be given over steps had been taken to release the academic portion of the Institute from its military partner. The same action was taken at other colleges.

It may be true that in the comparatively slow advance of technical education from Plato's day to ours and from decade to decade there are no lessons to draw; but, on the other hand, there are hundreds of overworked professors who gave the best that was in them toward a serious coöperative effort and who know that their work was thrown away.

There are also thousands of students, volunteering to help their country in the way that should have been most effective, who realize that they have wasted a school term. They will not become soldiers, on the one hand, and their academic work has suffered so much that to a considerable extent they will repeat the studies.

From the beginning the relationships of the army with technology have been those of unpreparedness and uncertainty. When the school for aviators was established the M. I. T. was obliged to furnish dormitories, beds and bedding, meals, instructors and apparatus. The army had practically no officers for the school, so the cadet officers of the institute's battalion were given commissions and cared for the school.

When the first school of military aeronautics was really well under way, with its courses determined and instructors well posted in their work, the army whisked it away and substituted a school of another character, and this again was later removed or discontinued and a school for aviators returned. It was the institute and not the army that solved the various problems in connection with the administration of the schools in matters not strictly military, and this at considerable inconvenience and disadvantage.

Now, the Massachusetts Institute of Technology was in every way fitted to be a school for training military engineers. This had been evident for a number of years to the professor of military science, Major E. T. Cole, U. S. A., retired, and he endeavored to convince Washington of the fact. He failed in his efforts till war was actually declared.

The institute people were perfectly well aware that war was at our doors. Nearly two years before war was declared the seniors, together with some instructors, formed an engineering corps and put much spare time into radio engineering, electrical work, topography and military engineering, with practice in the field and a camp or two. Many of these men have since been in actual service and have been advanced through special knowledge of which they here laid the foundations.

When war was declared the War Department sent a commission of officers to look the institute over and see where it fitted in in military engineering. The report of this commission is one of the most complimentary indorsements that the institute has ever received. The commission reported in effect that with a selection of courses already in the regular curriculum, with the addition of one hour a week of military exercises, the graduates would be practically prepared for commissions.

This was in May, 1917, and the faculty of the institute prepared the outline of a four-year military option based on the findings of this commission. The outline was virtually accepted by the War Department, but delay was necessary to determine details. The opening of the school in October found no option accepted by the government, and to meet in part the enthusiasm of its students, who were anxious to be doing something, Technology formed an advance battalion suitable for the men ready to take the military option. By the time this was well started the War Department arranged some details, and two units of the Reserve Officers' Training Corps were formed and the advance battalion was given up.

A Great Coöperative Plan

With an experience like this and the absence of a well-defined policy some of the members of the faculty regarded the plan of the S. A. T. C. with some misgivings. The whole matter was a sudden move. In the middle of the summer President Maclaurin was called to Washington, and there, in extraordinarily short time, he with his war education committee outlined a plan of coöperation between the military and academic forces that was admirable. This made the commandant a member of the faculty and left the control in the hands of the president. It was adapted with rare skill so that each college should help by giving to the young men the studies it was best fitted to impart. Meanwhile they were to receive a judicious schooling in matters military. The planning of this great piece of coöperation was one of the most patriotic bits of work that have been done in this country.

In 400 to 500 colleges the faculties worked like beavers through the heat of the summer molding their studies into form acceptable to the army, while the members of the committee oscillated between torrid Washington and their homes.

For an example of what changes were made there is the new curriculum at the M. I. T. Instead of four years with two terms each of fifteen weeks, the terms were shortened to twelve weeks and four of them were packed into the fifty-two weeks of the year. This involved excision—the humanities largely had to go—rearrangement and compression. From it young men would become engineers with all the essentials of the usual education, and these men could be placed at their country's service in two years. The great work of rearrangement with preparation of special courses was done by Sept. 30, only eight weeks or so after Dr. Maclaurin was called to Washington. On the day appointed the whole machinery was ready to start—truly a marvelous accomplishment.

In the interim the colleges were obliged—in order to be ready—to make important changes in their buildings. At the M. I. T. it meant accommodations for 1600 S. A. T. C. men, with mess hall, kitchen, stores and utility houses, which cost many thousands of dollars.

Obstacles That Arose

Meanwhile legislative and other destructive agents were busy making holes in the plans of the war education committee. It had been the intention to induct the young men into the army and then release them on furlough for the period of their studies. Apparently after it had set the S. A. T. C. in motion the War Department found that the furlough idea could not legally be carried out. The students were therefore placed in the status of enlisted men with no guarantee that they would be allowed to remain in college after other men in the same age group were called. They were soldiers and must be under the control of their officers. This disposed of any amicable sitting in of the commandant at the faculty meetings.

As soon as the S. A. T. C. was started it became evident that some of the officers considered the colleges merely as recruiting grounds. One group of young men at Technology who registered Monday were detailed on Thursday to Fort Monroe. One of them had been at the institute only two days, it is said, a brief time indeed for a young man to study at the school of his selection. It is, of course, true that they went away willingly, but that it was possible for them to go at all in such short order exposes the absurdity of the system from the viewpoint of technical education.

When such facts became known there were some changes in the officer group at some colleges, but the rigidity of the military system was felt everywhere. At this moment there is no college in the land whose faculty does not breathe freer now that the S. A. T. C. has gone by. It is perfectly true that they are most of them wondering to-day how they are to be reimbursed for the actual cash paid for improvements that are of no value or perhaps a hindrance now that the corps is demobilized. The War Department realizes that there are some difficulties. Every one agrees that the colleges ought not to be out of pocket for their patriotic acts of national assistance, but the legal considerations that could prevent the holding of selected officer material, or which say that the War Department can pay for no education in times of peace, are likely to create difficulty in meeting moral obligations.

The experiences with the S. A. T. C. at the Massachusetts Institute of Technology, represented to be less serious than in some other institutions, were not encouraging, although Colonel (formerly Major) Cole used every endeavor to give fair play to the educators. He encountered the fact that there was little appreciation among the army officers for academic education or else little ability to disregard the niceties of legal quibbling and cut red tape.

Some of the things that happened are almost worthy of vaudeville setting. The soldier after having lost his lectures through guard duty is transferred to another company and saddled with repetition duty without credit for his past. The hours for study are the same no matter what the mental capabilities of the student. Procrustean study periods they proved to be.

The absurdity of study periods at the end of a sixteen-hour day crammed with military exercise, calisthenics, studies and lectures became patent very early in the game, and students asleep through real fatigue were common in the academic work. What with the cessation of the lecture at the stroke of the clock whether the sentence was complete or not, the robbing of the student of the chance to get a word of explanation from the professor after his exercise, the delay for roll-call at the beginning of the lecture—twenty-two minutes, some one whispered, in one case from a period of fifty minutes—it is not difficult to realize the demoralization which the S. A. T. C. experiment effected. The students were discouraged, for they knew they could not make up the losses due to military duty that conflicted with academic exercises, and the instructors realized that so far as the studies were concerned they were a joke. The academic work was the tail of the military kite and met the fate of instability that befalls all tails of all kites. But, like good soldier material as they were, the students did their best and had no complaint; only through words of gossip were their real feelings made known, while the professors stood by their guns and patriotically did their best.

Discouraging as the experiment has been, it has a silver lining. It has opened the eyes of 25,000 college professors and 180,000 students. It has shown the advantage which military training depends upon—namely, discipline—although it condemns absolutely any such law-bound, ill-balanced attempt at coöperation as that which has passed. There is the greatest need of discipline in colleges—it is the American man's greatest need. The future of the country demands the avoiding of any such condition of unpreparedness as that which has characterized our past. Discipline and preparedness can be effected through the colleges, and now is the psychological moment in which to discuss and formulate a rational coöperation in education between the academic and the military.

Problems of Turbine Design*

Reliability and General Operative Excellence, Efficiency and Cost Constitute the Principal Considerations—Compromises Required in Low-Pressure Stage—Single Versus Multiple, Unit Versus Tandem Sets

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Experience with several large steam turbines, ranging from 30,000 kw. to 70,000 kw., was related in the Dec. 28, 1918, issue of the ELECTRICAL WORLD to show that reliable large units can be built, that they are not a fad and are advisable for large systems, and that no problems have been encountered within the commercial limits so far reached that cannot be solved by accurate analysis of conditions. This leads to a consideration of some of the most important problems of large steam-turbine design and their solution, which will be discussed in this article.

MANY conflicting factors are encountered in large turbine design that must be judiciously combined in order to secure the best evenly balanced design and one which will serve its purpose most satisfactorily. Reliability and general operative excellence must stand out as the dominating characteristics; second to this comes efficiency, and third comes cost.

The first and perhaps the greatest single problem is suggested in the theoretical design, viz., that of providing areas suitable to accommodate the enormous increase in volume of the steam while passing through the turbine. With steam supplied at the throttle at 250 lb. gage pressure and 150 deg. Fahr. superheat, the volume when exhausting to 28½-in. (724-mm.) vacuum is 166½ times, and when exhausting to 29-in. (952-mm.) vacuum is 241 times as large as it is at the entrance. This means that if the mean diameter and exit angle of all the rows of blading be the same and the ratio of blade speed to steam speed be the same in each, and if the height of the blades in the first stage be taken as 1 in. (2.54 cm.), the last row would have to be approximately 14 ft. (4.2 m.) if designed for 28½-in. vacuum and 20 ft. (6 m.) if designed for 29-in. vacuum. Here is where the combining of conflicting factors begins. In the first stages the areas and blade heights should be kept large in order to reduce the losses, and in the low-pressure stages they must be sacrificed on account of practicable limits of mechanical design. In single-cylinder machines where the blading is all on the same spindle the problem becomes doubly difficult.

The chief factor in the selection of the rotative speed is the design of the last row of blades with reference to height, diameter and exit angle, because this is the most important stage in the whole turbine. In order to secure the most satisfactory design and to prevent the stresses or physical dimensions with the ever-present cost from becoming prohibitive, several compromise features are employed.

The first of these consists of increasing the rotor diameter and blade heights, if necessary, until the safe limit of stress is reached, keeping the blade height within approximately one-fourth of the rotor diameter as a limit of good practice. The materials of which the rotor and blades are made will of course determine the safe stresses, and on account of the great import of safety and reliability in these parts only good quality

*For fuller details see paper presented before the A. S. M. E. at Philadelphia on "Notes on Large Steam-Turbine Design."

of plain or 5 per cent nickel low-carbon steels should be used, because these are commercially common materials, uniform in quality, and do not require sensitive heat treatments.

Increasing the diameter not only permits increasing the blade height, but also the steam speed, without materially affecting the efficiency, by reason of the increase in blade speed. There is, however, a slight falling off in efficiency with the higher speeds, even though the ratio of blade to steam speed be kept practically constant, because, the actual velocity of the steam with reference to the blade being greater, the frictional losses will be greater.

FIG. 1—BLADE FASTENING

The second compromise consists of increasing the steam passage area through the blades by changing the blade shape. This change increases the angle between the direction of steam flow from the blade and the direction of the blade, and a slight impairment of efficiency results therefrom. However, this loss is slight compared to the gain from the higher ratio of blade speed to steam resulting from the increased area. This practice is standard on practically all condensing machines built for high vacuum. The third compromise consists of permitting the steam speed to increase without a corresponding increase in blade speed, thereby decreasing the ratio of blade speed to steam speed and increasing the leaving losses. This compromise may properly be employed up to the point where the loss of efficiency will justify the increased expense of greater blade areas, which may necessitate dropping to a lower rotative speed or employing multiple stages.

Two or more low-pressure stages in multiple in connection with a single high-pressure stage are used when the required areas cannot be obtained with a single stage at the rotative speed chosen and when it is more feasible to employ multiple stages than a lower rotative speed. Other considerations favoring multiple stages are (1) reduced physical dimensions of the exhaust chambers, simplifying both the ribbing and bracing necessary to maintain the proper rigidity, and of the cylinder-supporting structure, including foundations, and (2) limitations of shipping dimensions established by transportation companies.

FACTORS IN DESIGN OF HIGHER STAGES

The design of the higher stages usually involves only an equitable selection of diameters, blade speeds and steam speeds. Keeping these low results in low stresses and high efficiency but large number of stages and high cost, while keeping them high reduces the length, weight and cost but increases stresses and impairs efficiency.

If the steam volumes in the first stages are relatively small for the rotative speed employed, as would be occasioned by the use of high steam pressure or low rating, a double-velocity stage impulse element may often be employed to advantage, the advantages secured being reduction of length, increased diameter, reduced pressure and temperature inside the main cylinder and adaptability for varying overload capacity.

Having fixed the rotative speed to secure proper design of the low-pressure stages, and the diameters and steam speeds of the high-pressure stages to give the highest economy, the length of the rotor may become excessive, necessitating its division into two parts in order to maintain requisite reliability. These parts may be arranged either in tandem form, driving a single generator, or in cross-compound form, driving two generators. When arranged cross-compound it will often be found advantageous to increase the rotative speed of the high-pressure element, thereby gaining reduced physical dimensions, weight and cost without sacrifice of efficiency or reliability. The multi-cylinder construction is especially desirable in the employment of high steam pressures and superheats in that the high-pressure turbine structure is small and there is no danger of stress complications resulting from wide temperature differences and no transmission of heat through the cylinder walls from high-pressure or low-pressure stages. It has a further advantage in these days of increasing steam conditions in that a unit may be designed for given steam conditions and later redesigned for materially higher conditions, the redesign being entirely carried out in the high-pressure element.

In units of 60,000 kw. or larger the three-cylinder cross-compound construction employing one high-pressure and two low-pressure elements possesses the advantages of high efficiency and reliability without employing excessively large structures and has greater flexibility than is possible with either of the other constructions. This flexibility, enabling the high-pressure element to operate with either low-pressure element, or either of the three elements to operate alone, admirably adapts it for use in systems not yet large enough to permit employing a single unit of such large capacity. These units may be provided with a control mechanism by means of which either of the elements may be taken out of service either automatically or manually, through operation of circuit breakers or automatic stop governor, and the remaining ones will continue to operate, carrying loads up to the maximum ratings of their generators. The low-pressure elements, when operating on high-pressure steam direct, may be made to carry loads for short periods considerably in excess of the rated capacities of their generators.

Reliability and general operative excellence of a large turbine are largely dependent on the excellence of design of details such as the blading and blade fastenings, provisions for maintenance of clearances and alignments under all possible variations of operating conditions, bearings and oiling system, control mechanism, glands, couplings and protective devices against overspeeding.

The chief destructive element of all blading is vibration caused by the flow of steam and by vibration of the entire rotor when operated under conditions of defective balance or alignment. The thickening of the blade section near its base serves to reduce very considerably the amplitude of its vibration and to prevent concentration of deflection with its attendant crystallization at the point of attachment, where the ordinary

blade is weakest. Blades may be lashed together to minimize the vibration and maintain uniform spacing. Blades up to 4 in. (10 cm.) in height may have a single lashing near the top, blades from 4 in. to 12 in. (10 cm. to 30 cm.) may have two, and blades above 12 in. may have three.

To insure maintenance of clearances and alignment under all possible variations of operating conditions, such as reduction of steam pressure and total or partial loss of superheat or vacuum, is difficult but essential. In such large structures the amount of expansion and contraction due to temperature changes is considerable and usually occurs simultaneously with important stress changes caused by varying stage pressures; consequently a comparatively slight uneven temperature change or unbalanced stress will cause a distortion.

The introduction of high vacuum, bringing with it large diameters in the low-pressure stages, and enormous exhaust chambers necessitates a considerable amount of carefully devised ribbing and bracing in order that the bearings supported in the exhaust chamber structures shall under all conditions remain concentric with the stationary blade or nozzle-carrying elements.

Practically every turbine element contains three bearings, two to support the rotor and one to maintain the longitudinal alignment. The supporting bearings usually consist of heavy cast-iron shells lined with babbitt and split horizontally to facilitate removal. Kingsbury type bearings modified to serve the requirements of the turbine upon which they are used are used extensively for alignment. The oil-circulating system

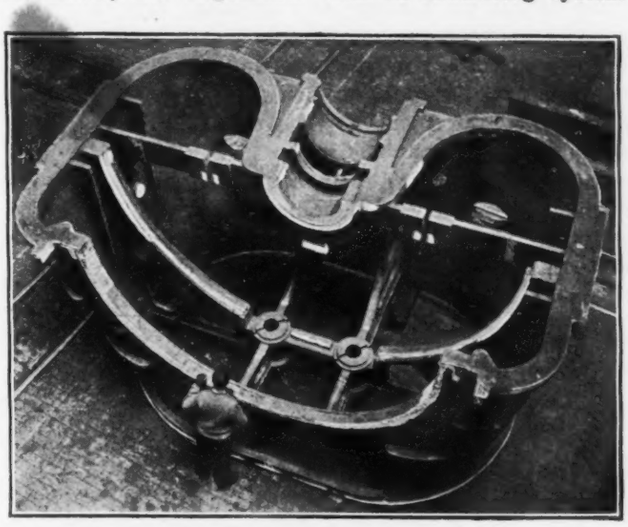

FIG. 2—BRACING OF EXHAUST OUTLET FROM TURBINE

should be designed with special reference to positive circulation, effective cooling, straining and settling for separation of foreign matter or impurities, accessibility for thorough cleaning and longevity of the lubricating qualities of the oil. Under normal operating conditions the maximum temperature of the oil should not greatly exceed 140 deg. to 150 deg. Fahr.

Since not only continuous service but also constant voltage and frequency have become a passion with public service companies, and a most commendable one too, the governing mechanism must be extremely sensitive, positive and quick to adjust itself to small or large changes in load and at the same time be rugged, reliable and unaffected by such variations as occur in ordinary wear and care. On account of the power required to operate the large valves, some form of relay mechanism is necessary. For this the regular turbine lubricating oil under suitable pressure has proved satisfactory.

Combination labyrinth and water glands constitute an excellent sealing arrangement to prevent leakage of steam or air where the rotor shaft passes through the casing. They require no adjustments for varying load conditions and do not depend on the operation of any automatic devices. There is no mechanical contact between stationary and rotating parts, and therefore no wear. They are extremely simple in design, requiring no special attention, and are as durable as any other part of the machine.

The simple water gland is not adapted to operation at high pressures or at speeds very much less than normal, but a labyrinth enables establishing a vacuum before starting up and reduces the pressure on the water gland when the pressure against which the gland must seal is high.

Flexible-pin couplings have important advantages over the solid-claw type in that sufficient elasticity is provided to distribute the shocks produced by heavy short circuits without danger of injury to the coupling.

These observations may aid in establishing a deeper appreciation of the present and prospective future growth of the electric power industry, of the need therein of generating units of large capacities, and of the fact that such units have been built and are commercially successful and that there appear to be no engineering, manufacturing or economic hindrances to their general use.

A REVIEW of past performances in the use of fuel will show that one industry and one alone stands preëminent as an efficient user of fuel. I refer to the central-station industry. For reasons over which this industry has had but little control, it has, regardless of any desire of its own, been forced to set the pace in all-around efficiency, and particularly in fuel efficiency. The natural outcome of this is that the central station has played one of the biggest parts in the winning of the war—a part that, while never in the limelight, was nevertheless so vitally important that its interruption would have instantly paralyzed practically the entire war machinery of the nation. . . . With the foregoing in mind, I would like to suggest that all state fuel administrators immediately inform themselves as to the present status of the central-station industry and give the subject such study as will enable them at a later day to be in a position to direct the movement of fuel and finances into avenues which will keep ours the foremost of commercial nations of the world.—*W. G. Williams, Head of Oil Conservation Activities in the Mid-Continent Field.*

Artificial and Natural Industrial Lighting

Their Interrelations Considered—Predetermination of Artificial Lighting Requirements—Variation in Natural Lighting Intensities—Importance of the Daylight Factor—Methods of Measurement

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The following article is based in part on information gathered during the war at the request and for the use of the Employment Management Division of the War Industries Board. This information has been used as a partial basis for the present article and for several articles to follow with the permission of this division of the board. One of the main purposes in giving wide publicity to these data, in addition to their use for the specific applications of the employment management division, has been to aid the industries in the readjustment period following the war. In this way the outstanding lessons which have been brought home under pressure of the war emergency can be utilized in their fundamental aspects to raise the standards of normal industrial activity.

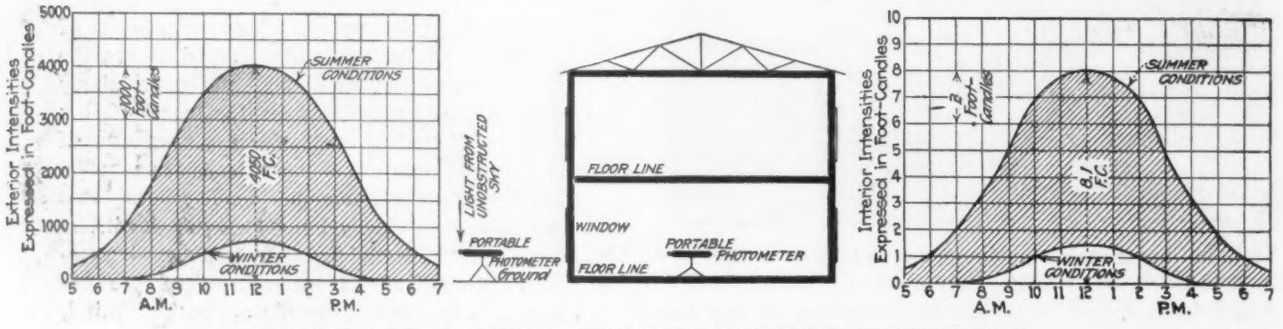
A WORKING environment which is highly favorable to the employee is now an accepted principle with persons who are concerned with modern industrial management. The logical conclusion drawn from this principle is that adequate natural light is of prime importance in any industry not only from the standpoint of efficient workmanship but also from that of the best interests of the management of the plant in general. It is not the purpose, however, in the present article to go into this side of the question, but rather to point out how inadequacy of natural light may effect the requirements for artificial light. This side of the subject is of considerable consequence to the electrical engineer in his appreciation of the artificial lighting problem.

It will be assumed in the following discussion that the presence or absence of adequate natural light may entail the three following characteristics: (a) The amount and distribution of the natural light should be such that every employee is suitably provided with the means for the best workmanship, and persons in charge of the management should have equally good facilities. (b) Any factory which has an excellent distribution of daylight throughout its entire floor space quite naturally has a greater value from the manufacturing standpoint than another factory in which the daylight conditions are inadequate and poorly distributed. (c) That plant in which the natural light is inadequate at those portions of the day when natural lighting would presumably be sufficient if the window areas were large enough has a larger requirement for artificial light than otherwise.

PREDETERMINATION OF PROBABLE ARTIFICIAL LIGHTING REQUIREMENTS

In an old factory where no provision has been made for an effective artificial lighting result it is possible by the methods described below to predetermine approximately the probable requirements for artificial light during the various months of the year. In many cases where the management of a plant is confronted with the necessary expenditure for a new lighting system little or no information is at hand in regard to the probable amount of time per day in which artificial light should be available. It is for such cases in particular that the following notes should be suggestive.

Again, in planning a new system, the intensity of illumination for a given class of work depends to some extent on whether the artificial light is to be used exclusively during night hours or whether it is to be used for a part of the time in conjunction with some natural light, for example, in the early morning hours of winter months. The scheme outlined below may also prove useful in the establishment of this point, since it indicates in a general way what proportion of each day in the summer and winter months given sections of the plant have daylight intensities which are so low that artificial light is essential. Thus, if it is found after such a study has been made that the artificial light will be required for a considerable portion of the normal daylight hours, then the intensity of illumination adopted for the given plant may be made considerably higher than if the use of the lighting system were limited solely to night hours. Conversely, if such a study of the conditions in the plant indicates



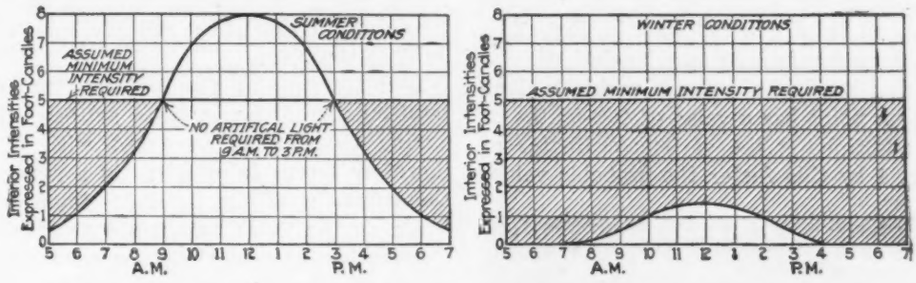
FIGS. 1, 2 AND 3—VARIATIONS OF DAYLIGHT; ARRANGEMENT OF INSTRUMENTS

Fig. 1 shows variations of daylight on a horizontal plane under the open sky in a given geographical location. Fig. 2 gives the set-up of instruments for making simultaneous measurements of inside and outside illumination for establishing the daylight factor at a given point in a plant. Fig. 3 indicates light illumination within a plant at a given point based on an assumed daylight factor of two-tenths of 1 per cent.

that the daylight intensities are sufficiently high for efficient workmanship for the day shift throughout the year, thus limiting the use of artificial light to night hours (excepting, of course, those special cases where storms make it necessary to turn on the lamps during the day), the intensity of the illumination may be made somewhat lower than otherwise.

It is well to remember, however, that even where the use of the artificial light is limited to the night hours its intensity should be sufficiently high to gain the benefits of the high efficiency in production which has been found to exist in those plants where the intensities of the natural illumination throughout the day out under the open sky in a typical winter month for one given geographical location. By way of contrast the upper curve shows the corresponding variations in the intensities of the natural illumination under the open sky throughout a typical summer day in the same geographical location.

The differences in the ordinates of the two curves, as shown by the shaded area in Fig. 1, indicate how much lower the intensities may be under the open sky in winter than in summer. These two curves show, therefore, that the variations of the natural



FIGS. 4 AND 5—ILLUMINATION NECESSARY TO SUPPLEMENT DAYLIGHT IN FACTORY

The horizontal line in Fig. 4 represents the assumed illumination which should be provided for a given class of work within a factory, while the ordinates of the curve represent the probable illumination at this point due to the factory windows. This diagram refers to the conditions of a typical day in summer, whereas Fig. 5 is a corresponding diagram for a typical day in winter.

artificial illumination has been made as much as three times the values considered adequate for a given class of work in earlier lighting practice.

Furthermore, it is sometimes desirable in planning a new system of artificial lighting to estimate closely on the maintenance cost of various proposed systems. Such estimates usually call for a knowledge of the probable number of hours per annum during which the lighting system will be in service. Any scheme therefore which will indicate the number of hours of service per annum during which the light will probably be utilized, may serve as a basis for preliminary estimates on maintenance.

One reason why so much difficulty is experienced in reducing the natural-lighting problem to the same definite basis as is now possible with artificial lighting systems is the extreme variations in the intensities of natural light. This is well illustrated in Fig. 1, in which the ordinates of the lower curve indicate the illumination are very great from hour to hour in the typical day, and furthermore that the differences between winter and summer months are also very great. To these normal variations there must also be added the erratic changes which take place on many days due to clouds, fogs, storms and the like.

The curves in Fig. 1 also give a measure of the variations of natural light which occur within any factory, because, obviously, for a given window area when the exterior illumination is high the interior illumination will be correspondingly high, whereas when the exterior conditions are low the illumination in the interior will decrease proportionately.

FIGS. 6 AND 7—FACTORY INTERIOR, SHOWING THE DISTRIBUTION OF NATURAL AND ARTIFICIAL ILLUMINATION

As a measure of the difference between the interior and exterior illumination the "daylight factor" has been proposed. This factor relates to the ratio of the illumination at a given point within a building to a corresponding illumination at the same point if the walls and ceiling could be removed, thus exposing the given

point to the open sky. In practice simultaneous measurements may be made at a given point within the plant and at some point exterior to the plant which receives direct light from the unobstructed sky. The ratio of the interior intensity to the exterior intensity gives the daylight factor in question, a general set-up for such a test being indicated in Fig. 2.[1]

Experiment indicates that this ratio of the interior to the exterior intensity remains practically constant throughout a given day and is practically independent of the season of the year. Having found this factor, therefore, for given typical points within a factory and knowing the trend of the variations in the exterior daylight as indicated in a general way in Fig. 1, a number of interesting conclusions may be derived.

Let us assume that the daylight factor within a given plant and at a given point has a value of two-tenths of 1 per cent. By multiplying the various ordinates of the curves in Fig. 1 by this factor the probable values

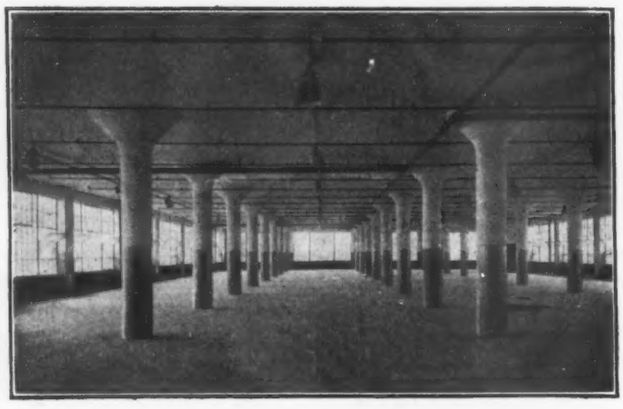


FIG. 8—WELL-LIGHTED MODERN FACTORY INTERIOR

of the interior illumination at the given point throughout typical summer and winter days may be plotted as in Fig. 3.[2] The upper curve in Fig. 3 indicates the probable interior intensities at the given point during a typical summer day, whereas the ordinates of the lower curve indicate the corresponding intensities for a typical winter day. The shaded area, which is the difference between the summer and winter conditions, indicates how much lower the daylight illumination will probably be at the given point during the winter days in contrast to those of the summer. Similar curves may readily be plotted for other typical points throughout a given factory area, but in themselves they are not so convincing perhaps in showing the needs of artificial light as the diagrams of Figs. 4 and 5.

Fig. 4 contains a horizontal line, the height of which represents, to scale, the minimum intensity of light which is assumed to be necessary for a given class of work. On this same chart a curve corresponding to the upper curve of Fig. 3 is plotted. The shaded portion of Fig. 4 indicates those parts of the day when artificial light must be employed to supplement the natural light, or, in other words, it indicates those portions of the day when the natural light is inadequate. Fig. 5 shows a corresponding diagram for a typical day in winter.

It follows at once that at those points in the factory where the daylight factor has the assumed value of two-tenths of 1 per cent artificial lighting will be required on the average before 9 a.m. and after 3 p.m. during the typical summer day, and for the entire day during the typical winter day. With this information in hand it is now possible to compile a table of the probable number of hours per annum when artificial light will be required during what may be considered normal daylight hours, which, coupled with the number of hours at night during which the artificial lighting system must be employed, forms a convenient basis for the determination of the relative importance of artificial light to the plant.

Such information also indicates the proportion of the total number of hours when artificial light is required during the day as compared with night hours, and therefore serves to establish in a general way whether the intensity of the artificial illumination should be based on the value considered desirable when used in conjunction with daylight or not. Of course, where charts of this kind indicate that the artificial lighting will be required almost exclusively for night hours a somewhat lower intensity might be employed than otherwise, on account of the absence of any daylight to conflict with the artificial illumination.

The same data may be utilized to establish the probable number of hours per annum during which the artificial illumination will be used, thus serving as an aid for preliminary estimates on maintenance cost.

Highly satisfactory artificial illumination for the spaces of tall buildings represents in certain cases a cost of approximately 2 per cent of existing rental charges. It is quite easy to conceive therefore that it would be considerably cheaper to use a building of many stories and employ artificial light for the lower floors than to limit the building height merely for the purpose of improving natural light, this statement of course having no relation to other advantages that might be secured from the hygienic standpoint if better natural lighting conditions were made available for the occupants of such lower floors.

A discussion of the interrelations of artificial and natural light should logically include a reference to the combination of natural and artificial light when the latter is used during those hours of the day when natural light, although inadequate, is present. First, the writer wishes to point out that artificial light which is entirely satisfactory at night when employed in the daytime fails to give the same stimulus to vision as at night (of course, this is not a new idea). Thus with the approaching twilight of a winter's day, when the artificial light is turned on, the conflict of the two results in a number of interesting happenings. One of these, as just intimated, is the lack of satisfaction which may be felt with the artificial lighting system at such times. One of the important points in the above discussion has been to bring out ways and means by which a determination may be made prior to the installation of a system showing whether or not the intensity should be made higher to take into account this very point. Based on wide observation, it would appear that some allowance should be made in every

[1] Extended discussions of the "daylight factor" and some of its relations to plant management will be found in articles by the writer in earlier issues of *Industrial Management*, the *American Machinist* and *Machinery*.

[2] Note carefully the differences in the scales of ordinates in Figs. 1 and 3.

system for added intensities in such cases to make the lighting system satisfactory at those periods of the day when artificial and natural light combine.

Another interesting result which has been mentioned from time to time is the tendency for an increase of accidents at those periods of the day when natural and artificial lighting are combined. While this may be due in part to lack of satisfaction from the artificial lighting system when in competition with the natural light, it is also quite likely that differences in the directions with which the light reaches the work from the two sources is somewhat responsible. Thus, with the windows placed at the extreme sides of the buildings, the shadows and general outlines of the work may be entirely different from those due to the light from a nearby lamp or from overhead lamps where such a system exists, and this may result in confusion in the judgment of a punch-press operator, for example, resulting in an accident which might not occur under other circumstances. This would seem to strengthen the argument that in the late afternoon when the artificial lighting is turned on it should be of sufficiently high intensity to predominate sharply over the inadequate daylight.

The foregoing notes may be illustrated in a measure by a number of actual examples, which are merely included to give a better idea of the physical points involved. Figs. 6 and 7 are comparative views[3] of a section of an industrial plant showing the daylight and the artificial lighting conditions respectively. It is hardly possible to examine comparative cases of this kind without being struck with the great advantage of supplying illumination from overhead rather than from the side. Thus, in this view the natural lighting is received from the windows on the sides of the building, while the artificial illumination is distributed from overhead lamps which are placed symmetrically with respect to the floor. From this point of view the advantage of roof day-lighting in single-story buildings is at once apparent. An interior of a factory in which particular attention has been given to natural as well as artificial illumination is shown in Fig. 8.

Economical Operation of Hydraulic Turbines

Discussion of the Losses Incurred in Running Such Installations—Hydraulic Losses in the Setting and in the Turbine—Mechanical and Operating Losses—Importance of Thorough Cleanliness

BY E. A. GIBBS, S. MORGAN SMITH COMPANY

THE over-all efficiency of a hydraulic turbine installation is made up of two parts, namely, the efficiency of the turbine proper, consisting of the runners, regulating gates, bearings and draft tubes, and the efficiency of the setting, consisting of the headraces, supply pipes, wheel casings, flumes, wheelpits and tailrace. The product of the above two efficiencies will be the over-all efficiency of the turbine installation. Consequently, if the over-all efficiency of the installation is to be kept at a maximum, neither of the above efficiencies should be allowed to decrease. In discussing how the highest over-all efficiency can be maintained it will be assumed that the turbine has good efficiency, and likewise the setting. The losses that can occur from operation will be discussed under four headings: "Hydraulic Losses in the Setting," "Hydraulic Losses in the Turbine," "Mechanical Losses" and "Operating Losses."

Hydraulic Losses in the Setting.—The headrace to the turbine should be free of obstructions of all kinds and should not be used as a dump. It should be cleaned out at specified periods, depending on the character of the soil through which it passes and on the character of the water. The latter may carry a considerable amount of silt and foreign matter, which is deposited in the headrace, filling it up. In order that the water may flow with minimum amount of eddies and cross-currents, the headrace surfaces should be kept as smooth as possible. To this end the banks should be kept clean (all cutting and washing should be carefully looked after) and vegetable growth under the water should be eliminated. Constricted sections in the channel should be removed, so that the water can flow with a uniform velocity the entire length of the headrace. If possible, the banks above the water level should be covered with grass, forming a sod, to prevent washing and slipping. If the water is conveyed to the turbine by steel or wood flumes, they should be cleaned at regular intervals, the time depending on the characteristics of the water.

Trash racks should be kept absolutely clean. On streams carrying floating débris this requires considerable work. In all plants it should be the duty of some one in particular to inspect the trash racks four or five times a day and clean them if necessary. The trash-rack area of most plants is none too large, and when the trash racks become clogged with débris the head often becomes seriously reduced. In low-head plants this is particularly serious. For instance, in one plant operating under a head of 10 ft. (3 m.) a loss of 2.5 in. (6.4 cm.) of head through the trash racks would mean a loss of over 2 per cent in the operating efficiency of the plant. The velocity of the water through the trash racks should not exceed 1.5 ft. (0.5 m.) per second for low heads under 20 ft. (6 m.) or be more than 2.5 ft. (0.8 m.) per second for heads above 20 ft. (6 m.), if maximum efficiency is to be obtained. There are cases where the head loss at the trash rack was 15 per cent of the available head, owing to the high velocity of the water through the rack caused by the rack becoming clogged with débris. With a systematic cleaning of the trash racks the loss of head will be reduced to a minimum. When trash racks are long mechanical cleaners should be installed.

The wheel pit should be of sufficient depth and should

[3]Figs. 6 and 7 are due to the Macbeth-Evans Glass Company, Fig. 8 to Stone & Webster.

be kept free of all obstructions. The tailrace should receive the same attention as the headrace, for the reason that deposits of silt and débris affect the head directly in the tailrace. High velocities should be eliminated from the tailrace as well as the headrace.

In all turbine installations a gage should be placed as near the turbine as possible, so that the elevation of the headwater can be easily noted. Another gage placed in the tailrace as near the discharge of the turbine as possible should be used to indicate the elevation of the tailwater. These gages should be calibrated so that the head can be readily determined and should also be read at regular intervals, the record being kept for reference.

In small streams a weir of sufficient length should be installed and readings taken and recorded, showing the amount of water flowing. The turbine can then be operated at the proper gate opening to correspond to the available water so as to obtain the maximum efficiency. The knowledge of the amount of water flowing in a stream at all times is one of the most valuable assets to water-power users on such streams. With such knowledge of the water available, and with power and efficiency curves of the turbine, high operating efficiency can be obtained.

Hydraulic Losses in the Turbine.—These losses are due mostly to lack of inspection and upkeep, excessive leakage of water being the result. When the chamber of the turbine directly above the runner is drained to the draft tube and the clearance between the top rim of the runner and the guide casing, called the "top running joint," becomes worn through lack of adjustment and repair of the steady bearing, a large amount of water is allowed to pass around the turbine and not through the runner. If the bottom running joint between the runner and the guide casing becomes worn excessively, owing to eccentric motion of the shaft or to the shaft moving endwise, excessive leakage of water will also occur, and consequently loss of efficiency.

The hydraulic losses in the turbine can be kept at a minimum by frequent inspection and rectifying the defects observed at once. Systematic inspections of the turbine should be carried out. Each turbine should be inspected at a specified time, at least three times a year. There are cases where turbines have run three or four years without any internal inspection, and there are no doubt cases where this time has been much longer, during which time the turbines were operating at a decreasing efficiency, owing to wastage of water. One thing in particular that is necessary is to keep the runners and gates clean and smooth. Breaking or erosion of parts so as to prevent the efficient utilization of the water power should also be watched for.

In the installation of hydraulic turbines in general not enough consideration is given to the methods and appliances for taking the water out of the wheel cases and flumes. Headgate operating devices are considered as only to be used in cases of emergency, when something happens, and are generally inferior in design and too small in capacity for the duty they should perform. Headgates and apparatus for operating them should be designed and built so they can be operated easily and quickly, and operated every day if necessary. In some cases, when it becomes necessary to take the water out of the wheel case or flume, several men must be secured to operate the hoists and close up the leaks in and around the gate with ashes, sawdust, etc. If headgates are designed and built so as to stand repeated operation and remain tight, and the hoisting apparatus is designed and built to operate the headgates easily, power-house attendants would give more attention to the internal inspection of the turbines.

Mechanical Losses.—Losses of this nature are due to non-alignment of the shaft caused by the bearing becoming worn and allowing the shaft to get out of its proper position. This causes undue wear on the running joints. The bearings should be frequently inspected and kept in correct adjustment so as to hold the shaft in its proper position. Thrust bearings should be looked after carefully and maintained so that the shaft will not move endwise out of its normal position.

Operating Losses.—These losses occur mostly in plants in which several units are installed when the load is such that all the units are not required to be in operation. The maximum efficiency of all turbines occurs somewhere between eight-tenths and full rating. By consulting the power and efficiency curves of the turbine, as furnished by the builder, the total load can be subdivided[1] among the several units, so as to obtain the maximum efficiency in operating the plant.

As shown, cleanliness, care and upkeep are the important factors in obtaining maximum efficiency in operating a hydroelectric plant, and it may be added that cleanliness can be applied to the interior of the power house as well as to the machinery. When a power plant has dirt, oil and water all over the floor it indicates that the plant is not efficiently operated and that there are a lot of lazy operators in charge, with a superintendent or manager who is not "on the job."

With frequent inspections, careful upkeep, cleanliness and intelligent manipulation of the load, economical operation of the hydraulic turbine will be achieved.

[1]See article by Lieut.-Col. Hirshfeld and C. L. Karr in ELECTRICAL WORLD for Dec. 21, 1918.

THE United States is the richest of all countries. It possesses one-third or more of the total wealth of the world. It has become the leader of finance and in this respect may properly exercise a commanding influence. Its natural resources are immense and are susceptible of increasing development. If industry is protected and fostered in accordance with its merit, the war burdens surely, even though gradually, will be lifted. We shall be a creditor nation with a large interest income, more virile, more progressive, more successful, wiser and better than ever before. . . . It remains for all who have been permitted to survive the horrors of war to enter upon the new era with a united and fraternal spirit and a fixed purpose to profit by the experiences of the past and to aid in the establishment of a permanent basis of peace and prosperity.—*E. H. Gary.*

Radio Development in the Air Service

Problems Which the War Has Left Still Unsolved—How Shall Satisfactory Communication from One Plane to Another or from the Ground to the Air Be Attained?—Necessity of Policing the Air a Factor in Problem

BY LIEUT. EDWARD R. DOYLE, AIR SERVICE, U. S. A.

MANY engineers who have followed the rapid improvements in radio apparatus in the air service will be keenly interested in the solution of those problems which the war has left unsolved. Those of an inventive and scientific turn will endeavor to overcome some of the difficulties encountered. While the program of the air service may not be carried out as elaborately as heretofore, it is unquestioned that the technical needs of the service will be pushed without relaxation. This is especially true of the radio work, which began as a by-product of the war and which opens up unlimited possibilities with the increasing utility of the aëroplane.

It can be said that the spark telegraphic sets were fairly satisfactory for the purposes for which they were designed. The simple storage-battery type with the trailing antenna for use in fire control was reliable enough, though its tuning was a difficulty on the closely crowded sectors whenever many radio ships tried to work close together. The fan-driven generator sets with more diversified tuning and greater radiation were developed with minor difficulties of design, and the adaptation of the aëro engine as a source of power was only a logical step where the fan drive was impracticable.

However, in the use of the wireless telephone, where communication from plane to plane is desirable, and more especially communication from the air to the ground or vice versa, the antenna problem has not been satisfactorily settled.

A satisfactory telephone aërial requires (1) that the antenna must be non-directional, (2) must be adaptable to all flying conditions, and (3) tuning must be conveniently regulated while in the air to all ranges of wave length.

The ordinary trailing type of antenna throws the radiated signals in the direction in which the ship is moving and at an angle of about 45 deg. downward from the horizontal axis of the ship, so that to each side and behind there are zones of low audibilities, and on banking or turning the signals fade out. This is therefore not adaptable for the radio-telephone since its signals would only reach a ground station from certain limited positions and render ship-to-ship or ship-to-ground communication impossible in the majority of cases.

As for the reception of signals from the ground, it would require the ship to fly directly toward the ground station, and the ground aërial would have to have a radiation upward, which is not the case with ordinary L-type antenna. The ground problem, however, is logically considered as a special case.

Other types of ship antennas have been tried. Most successful of these is a double trailing antenna with the aërials trailing from the outer-bay rear struts and using very light wire without weighted ends. It gives a good heart-shape radiation in the horizontal plane of the ship (and to ground for limited heights) which is satisfactory for formation flying. The point of the heart is opposite the direction of motion. Here little difficulty is had while in the air, where the leading ship does the transmitting, but owing to the fact that the ship must start and land with its aërials trailing, frequent losses of wire occur and result in change of wave length if not total failure to operate. The safety in insulating this type is not high and the installation is awkward for mechanics working on the ship. In aërial fighting the wires can be shot away.

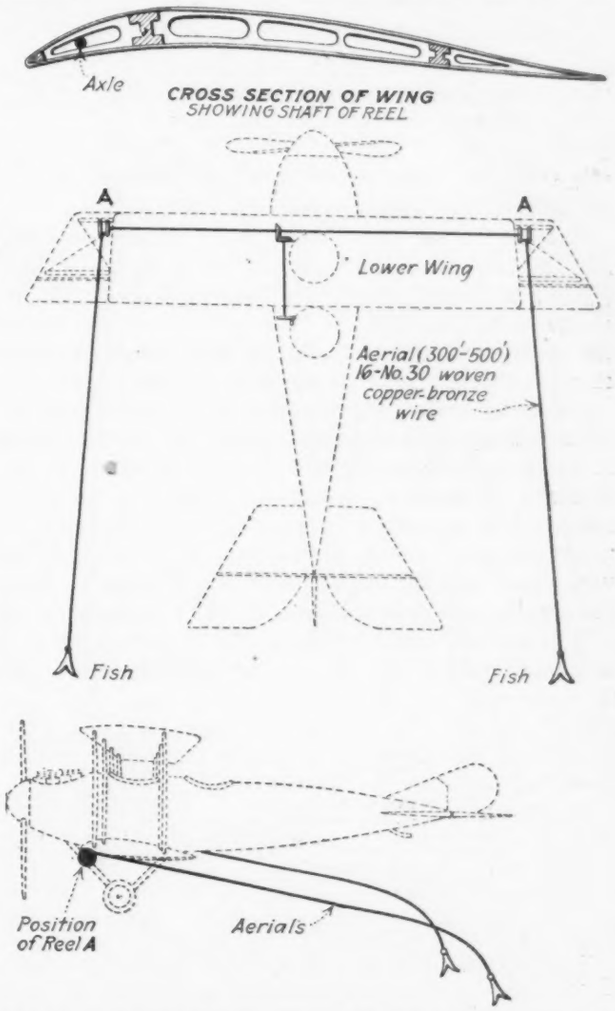


FIG. 1—ARRANGEMENT OF AERIALS TRAILING FROM WING ENDS

Wing-end aerials controlled as to accurate length by cross axle centered inside the wing sections and operated from fuselage (reeling in and out by hand wheel). Used as a counterpoise to combine radiation directly (1) downward and (2) straight ahead (and upward).

This type of aërial is not adaptable for reception from the ground, but with the aërials now in use for ground stations it is perhaps more the fault of the ground station aërials than the ship aërials that signals cannot be picked up readily.

The best type of aërial for transmission to ships from

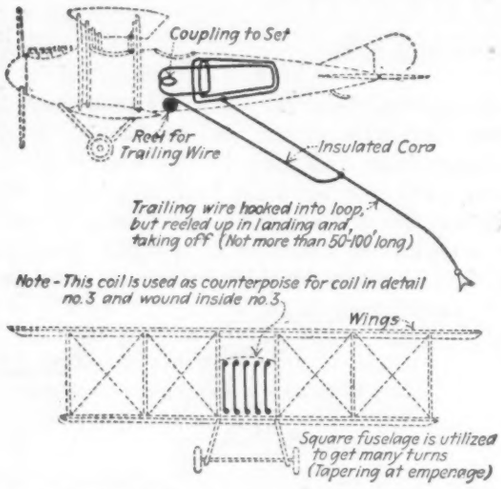

Coupling to Set
Reel for Trailing Wire
Insulated Cord
Trailing wire hooked into loop, but reeled up in landing and taking off (Not more than 50-100' long)
Note - This coil is used as counterpoise for coil in detail no. 3 and wound inside no. 3
Wings
Square fuselage is utilized to get many turns (Tapering at empenage)

FIG. 2—COILS FOR RECEIVING SIGNALS FROM GROUND

"Vertical" loop of from thirty to fifty turns heavy insulated braided wire depending on power of set. Coiled in the fuselage and used to detect signals from ground and for transmitting in conjunction with trailing wire. Used to receive signals from ahead (independent set connections from Fig. 4).

the ground is the umbrella aërial using high power input. Special features of design which will force radiation upward and not parallel to the earth have yet to be developed. The solution probably lies in the use of a counterpoise which will offset the effect of ground currents. Theoretically, if the ground aërial is inverted—that is, with the counterpoise at the normally "high potential" end and insulated in the air, and the "open end" still far enough from the ground to reduce the capacity effect of the ground—the conditions might be fulfilled. By shifting the angle of the counterpoise and aërial with respect to the vertical the proper direc-

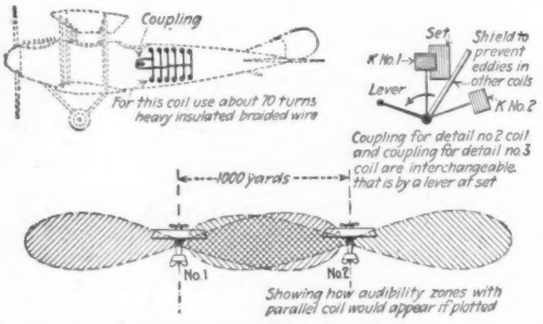

Coupling
For this coil use about 70 turns heavy insulated braided wire
Set
Shield to prevent eddies in other coils
K No. 1
Lever
K No. 2
Coupling for detail no. 2 coil and coupling for detail no. 3 coil are interchangeable, that is by a lever at set
1000 yards
No. 1
No. 2
Showing how audibility zones with parallel coil would appear if plotted

FIG. 3—SCHEME FOR RECEIVING MESSAGES FROM OTHER PLANES

"Parallel" loop used to receive from ships in air and on about same traveling plane—that is, going same direction; also used to send to ships at close range, as above.

tional control might be secured to talk with a ship at a considerable elevation. This feature would be especially valuable for aërial patrol work. A patrol ship at a high altitude can give chase to an invading enemy plane much more readily than one starting from the ground, owing to the loss of time and difficulties of maneuvering.

It is likely that the requirements for satisfactory aëroplane aërials will be met by the use of a multiple antenna of some kind; that is, by extending aërials in the directions in which communication is desired and using loading coils for the adjustment of wave length. The ultimate aërial will be one combining compactness and directional control. Since the ship-to-ship communication normally is over short distances, a maximum of 1000 yd. (914 m.), closed oscillators of high directional effect may be used, with a trailing-type antenna and adjustable counterpoise for communication to the ground.

There must also be special facilities for tuning while in the air which have not been available thus far. A wave meter which can be cut into the aërial circuit will be needed so that the aërial observer wishing to communicate with a particular station can adjust his set to the specific wave length while in the air. Closer tuning will also be required to avoid interference, and with the continuous-wave generators this means an accurate wave meter in the receiving side with exciting source of power for adjustment.

Pilots frequently have difficulty in keeping their

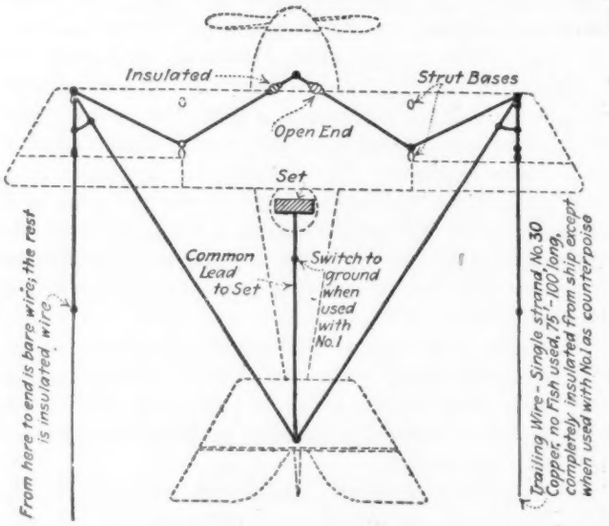

Insulated
Strut Bases
Open End
Set
Common Lead to Set
Switch to ground when used with No. 1
From here to end is bare wire; the rest is insulated wire
Trailing Wire - Single strand No. 30 Copper, no Fish used, 75'-100' long, completely insulated from ship except when used with No. 1 as counterpoise

FIG. 4—FOR CONTINUOUS WARNING SIGNAL

Wire antenna distinct from that shown in Figs. 1, 2 and 3. It is to throw signals forward and upward for continuous warning ahead. When not used as such, it serves with wires shown in Fig. 1 as a counterpoise to throw signals down (Fig. 2, transmitting). It is interesting to note that there is a neutralizing magneto field present in the engine which is very detrimental and must be overcome in some way such as shielding or grounding.

bearings on cross-country flights, and if facilities are available to call up known ground stations, they can correct their bearings and continue in a proper course despite clouds and atmospheric haze. For long-distance postal routes and passenger service this would be a big asset. A ship equipped with radio sets suitable for operation on the ground can summon aid if forced to land in a sparsely settled district. This feature of radio utility presupposes a large number of land stations. Doubtless they will come into service as the need arises.

As the aërial highways become more and more crowded, the need for wireless warning signals will increase. Aëroplanes travel at high speeds and one ship will pass another in a few seconds. Visual warnings are unreliable, and in fogs or at night the dangers are

greatly increased. Some system of continuous radiation in a direction directly ahead is needed. Two approaching planes properly equipped could be warned while 5 miles or 10 miles (8 km. or 16 km.) apart and thereby avoid any dangers of collision.

Hereafter the air will require policing the same as any highway, and if the policing planes cannot question a passing plane as to its cargo and character, there is no power to control traffic. This would indicate that in time laws will be passed requiring commercial planes to carry radio sets for this purpose.

The matter of interference will need serious consideration, and a likely solution is that a certain range of wave lengths will be restricted for aëroplanes only. Regulation of the power of the sets must also be considered and some method of standardizing the sets themselves be advanced so that their operation will be reasonably reliable.

The use of government planes in peace times as ambulance ships, for policing the air, forest fire patrol, mail and passenger service, sea patrol, life-saving service, etc., all suggest immediate utility of radio apparatus if properly developed. One-way communication has been a success in the war, but the ability to pick up and answer calls at various wave lengths while in the air has yet to be developed. The design of sets which will meet all these requirements is really simpler than the aërial problem. The military authorities are working on such problems now, but there is an open field for the engineer who can effect a solution.

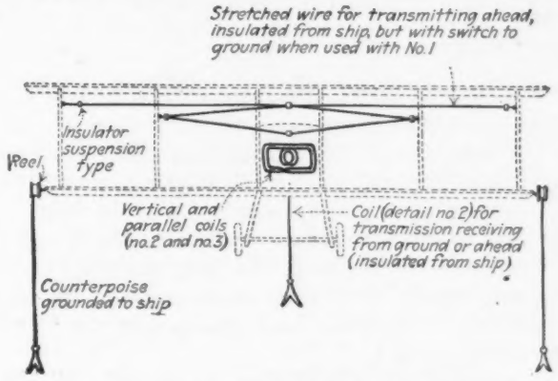

Stretched wire for transmitting ahead, insulated from ship, but with switch to ground when used with No. 1
Insulator suspension type
Reel
Vertical and parallel coils (no. 2 and no. 3)
Coil (detail no. 2) for transmission receiving from ground or ahead (insulated from ship)
Counterpoise grounded to ship

FIG. 5—COMBINED VIEW OF FIGS. 1, 2, 3, AND 4

Note that a plane so equipped could not maneuver with safety unless the driving power were offset; also, that to balance the weight of the coils the wires would have to be set farther back than on the ordinary training plane, but would be all right on bombing and weight-carrying planes.

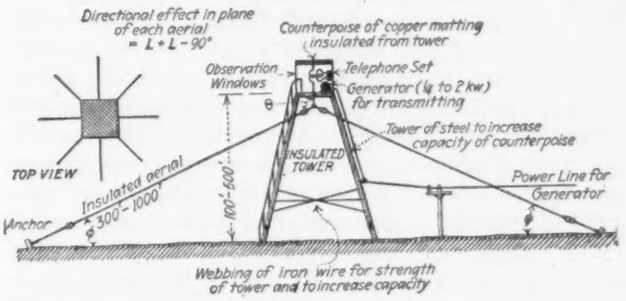

Directional effect in plane of each aerial = L + L - 90°
Counterpoise of copper matting insulated from tower
Observation Windows
Telephone Set
Generator (½ to 2 kw.) for transmitting
Tower of steel to increase capacity of counterpoise
INSULATED TOWER
TOP VIEW
Insulated aerial ø 300 - 1000
100 - 600'
Power Line for Generator
Anchor
Webbing of iron wire for strength of tower and to increase capacity

FIG. 6—INVERTED UMBRELLA AERIAL FOR GROUND STATIONS

The higher the tower and the greater L ø, the more directional effect upward. Each tower would be erected near a landing field.

An Entirely New Set of Problems for the Electrical Industry

BY JOHN B. MILLER
Chairman of the Board Southern California Edison Company

THE war brought entirely new problems—problems wholly outside of our own experience, problems of coördination, of production and of elimination of everything not essential to the war. Difficult and untried as were these problems, they were solved to a degree entirely satisfactory when the shortness of the time during which this nation actually was at war is considered.

Now that the war is over, we are again confronted by an entirely new set of problems. These problems are of many different phases, but have been given the generic term of "problems of reconstruction." We have little in our experience upon which to draw any help in the solution of these problems, and we can see into the future but a little way and that darkly, so that he who would lay down a general, cocksure plan at this time for the solution of all of these problems would be an exceedingly rash man and soon would be a prophet without honor in either his own country or any other. For that reason it seems to me wise to proceed slowly and with caution, one step at a time.

But I think all of us can recognize even as early as this that our main problem has to do with the replacement and employment of the men who left their occupations in civil life to go into the service of their country, and most employers plan to restore every old employee returning from the service, if not to exactly the same job which he relinquished at his country's call, to one at least as well paid. To do this will tax the resourcefulness of employers to the limit, but it must be remembered that ours is a business which by its very nature does not stand still but constantly increases with the growth of the community which it serves.

During the war all construction except that essential for war purposes was reduced to the irreducible minimum. On the Pacific Coast the pressure for new extensions is so insistent that there will have to be a great amount of construction—new power plants and new lines of transmission and distribution—and these developments will help to solve the first step in the problem of reconstruction indicated above, and as we proceed with that, we shall perhaps receive light with which to see a little farther ahead in the solution of the problems yet to come.

Substation Operation a Woman's Job

When Trouble Has Arisen the Average Woman Has Been Found to Be as Capable and Resourceful as the Average Man—No Complaints About Service Received from Customers of Michigan Company

BY H. J. BURTON
Superintendent of Instruction, Consumers' Power Company, Jackson, Mich.

GENERALLY speaking, the operation of generating plants and substations has always been looked upon as a man's job, and although the Consumers' Power Company has employed women as switchboard operators in some of its substations for several years, it was not until the past year that women were employed to take care of all of the work previously done by the male substation operators. The women, of course, were employed as a war measure to take the places of men who had left the company to enter military service.

The Consumers' Power Company controls over seventy generating stations and substations in Michigan where operators are employed. At the present time seven of the substations are operated by women, and B. E. Morrow, manager of the production and transmission department, states that the work done by the women operators is entirely satisfactory and that the women are more dependable than some of the men who are available for these positions at the present time. They obey instructions better, are more careful and less apt to experiment with dangerous and expensive machinery than the male novice. The women keep the stations and apparatus neater and cleaner than the average man. The operation of a modern substation is in many respects just as much a woman's job as is the operation of a telephone switchboard, and Mr. Morrow sees no reason why women should not continue to do the work even now that hostilities have ceased and the war is practically at an end.

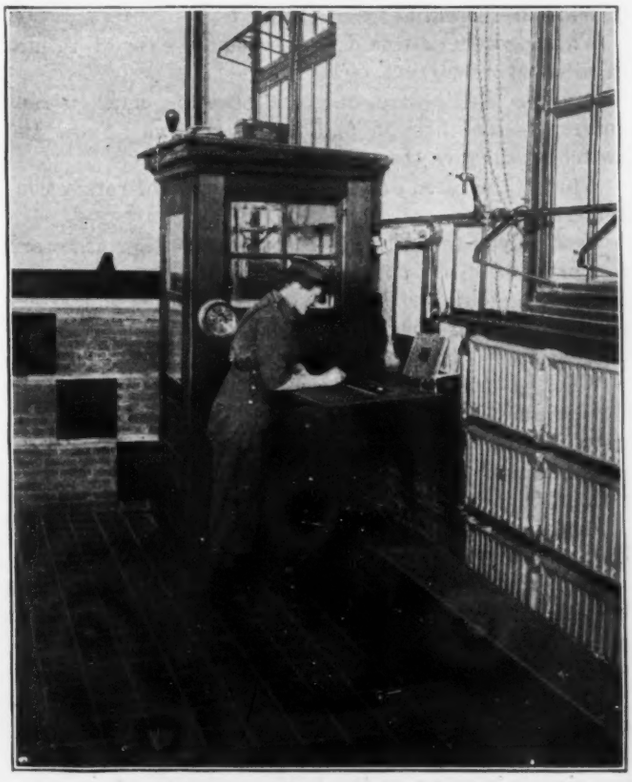
RIGHT TYPE OF WOMEN OBTAINED

Owing to the essential nature of the work applicants for the position of women operators were secured through the women's committee on placement, department of registration, and with the coöperation of this committee the right type of employee was found.

GROUP OF WOMEN SUBSTATION OPERATORS IN WORKING GARB

Most of the women started to take up the work through patriotic motives and a desire to serve the

country. At first the constant hum of the transformers and the noise made by the rotary converters and motor-generator sets bothered the women considerably. As soon as they became accustomed to the noise, however, they began really to enjoy the work. They realized that they were doing an essential task. They attained a



ENTERING RECORDS ON LOAD SHEET

broader outlook and better spirits, and it has been noted that they are healthier and that a general improvement in physical condition has resulted.

Operators must, of course, be mentally and physically qualified for the work they have to perform. They must be strong enough to be able to operate the large oil switches and the starting and running switches of the rotary converters and motor-generator sets. They must possess a good grade of intelligence in order to learn readily the meaning of simple electrical terms, learn how to read meters, learn how to figure the daily operating results and make clear and concise reports regarding operating conditions and results to the load dispatcher or system operator. It has been found that a high-school education is desirable although by no means essential, as some of the most competent substation operators have not completed even a full grammar-school education.

WORK ESSENTIALLY HOUSEKEEPING

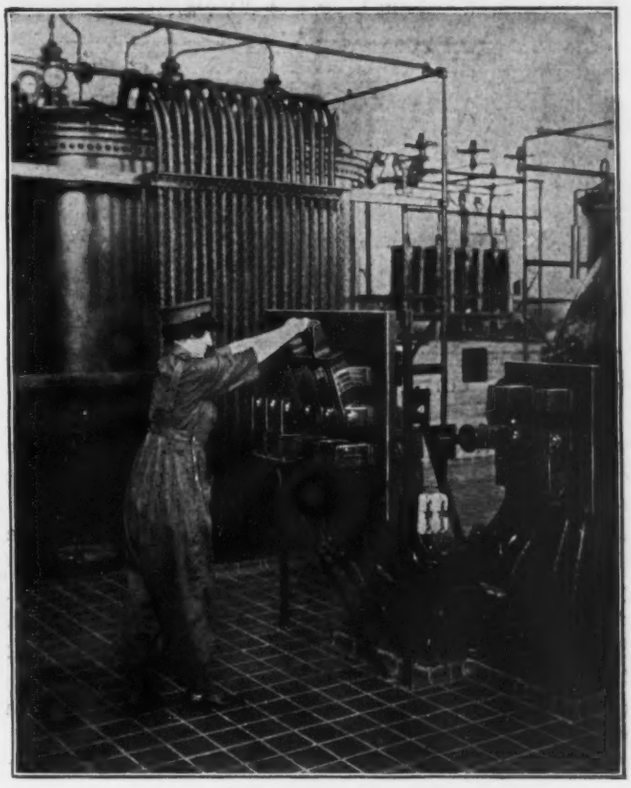
The work to be done in the stations is by no means physically fatiguing. Housekeeping is one of the most essential phases of the work. "A place for everything and everything in its place" is an excellent motto for it. One of the male substation operators who has just been promoted summed the situation up when he said: "It is really a woman's job; there is more housekeeping to it than anything else."

In the stations now being operated exclusively by women no complaints about the service have been made, and during trouble it has been demonstrated that the average woman is as capable and resourceful as the average man. It has been noted that the women follow instructions to the letter where the men follow them only in a general way. The women will take half-hourly readings exactly on time; with the average male operator a few minutes earlier or later does not seem to make any difference. The women are not so inquisitive about the apparatus as the men; for instance, they are not so apt without permission to take the cover off a meter or other instrument, to take it to pieces in order to find out "what makes it work or why it does not work." This does not mean that women are not interested in the work or the study of electricity; on the contrary, a number of them have purchased books on the subject and are studying in their spare time.

Very little, if any, trouble has been experienced due to lack of coöperation on the part of the men; in fact, most of the men have been very kind to the women and go out of their way to help them. The men realize that there is plenty of work for all and that the sooner there are others capable of taking their places the sooner they will be promoted.

The women have a shorter working day than the men. In stations where they do all the work previously done by the men they receive the same rate of pay.

So far no regulation uniform has been decided upon.



STARTING ROTARY CONVERTER

Most of the operators wear a one-piece working garment. In some of the stations the women wear short, narrow skirts while on general duty and put on overalls only when special work is to be done around the machines, such as cleaning and overhauling of the rotary

converters and motor-generator sets, changing brushes and work of like nature.

The time required to train an employee for substation work depends upon the local conditions: that is, the size of the station, the number of circuits and the nature of the service. In some stations two weeks is sufficient time; in others four weeks' training is necessary before all of the details can be learned. The new employee is first furnished with a copy of the general operating rules and instructions of the company and is placed in the substation under the care of one of the experienced male operators—one who is known to be in sympathy with the employment of women in the stations. For the first three days the new employee is

CUTTING IN ROTARY CONVERTER

not allowed to do any switching or to touch any of the electrical apparatus. She must study the operating rules of the company, get used to the surrounding conditions, and she must learn the names and purpose of all of the different pieces of apparatus in the station. New employees are given examinations by the instruction department before they are allowed to do any switching. The women operators must be qualified for the work they have to perform, and they are not allowed to operate until they have demonstrated their fitness for the work.

Following are some of the questions an employee must answer before she is allowed to operate:

What is the voltage and frequency of the transmission line that supplies energy to your station?

How many transmission lines feed station? Designate them.

Who has charge of all high-tension switching?

Are there any circumstances under which you would take instructions from any one else regarding high-tension switching?

What is the kilowatt capacity of your substation? Of your rotary converters? Of your transformers?

What is the voltage on the high-tension side of transformers? On the low-tension side?

What are series or current transformers?

What are potential transformers?

What procedure would you follow in case of failure of alternating-current power?

Draw a single-wire diagram showing how current enters, passes through and leaves station. Show the switches and give the voltages.

What is the rated direct-current voltage of rotary converters?

How do you find alternating-current voltage of rotary converter if direct-current voltage is known?

Explain step by step how you start rotary converters and motor-generator sets and place them on the direct-current bus. Give details for stopping them.

What is meant by reversed polarity?

What have you in your station to indicate whether or not your machines have correct polarity?

If reversed, how would you get them back to correct polarity?

Explain in detail how you change your aluminum lightning arresters.

State what procedure you would follow to report trouble in case you could not use the private telephone line to communicate with the load dispatcher.

Have you read the operating rules of the company?

What parts of the rotary converter or motor-generators require most attention? Why?

When opening a direct-current circuit would you open the circuit breaker or the knife switch first?

Can you operate with voltage regulator cut out of service?

State in detail how you would cut regulator out of service.

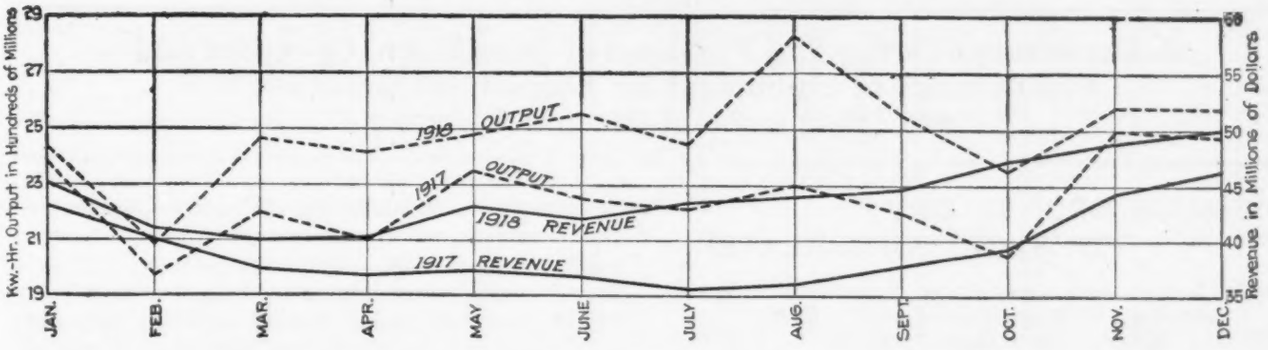
How many fire extinguishers are there in your station? Where are they located? Do you know how to use them?

Women Are Safe Employees

After a woman has been assigned to regular duty in a substation her instruction does not cease but she must continue to study. Periodical examinations are given to determine continued fitness for the work to be performed, and the operator's knowledge of the company's safety regulations is checked from time to time.

Women employees have proved themselves to be safe operators—they are quick to learn the proper sequence of opening and closing switches and the correct way to handle live conductors. Good housekeeping is one of the most important of the safety rules. The good housekeeper prevents accidents both directly and indirectly. Materials not in their proper places may directly cause an accident. The good housekeeper has everything in its place, the poor housekeeper has everything out of its place. Careless practices make careless employees. The operator in a modern substation should be a thinker. Brains more than brawn are required, and the woman operator has proved herself to be competent to handle the work. It is the writer's opinion that she is here to stay.

Central Station Operations in 1918



FROM the returns received by the ELECTRICAL WORLD it is estimated that the central electric stations of the country increased their revenue in 1918 about 12 per cent over 1917 and their output about 10 per cent. These calculations are made on the basis of the returns obtainable at this time. It will be recognized that they represent in part an estimate of what the companies in all sections of the country showed during the twelve months.

It is more difficult than usual to form a judgment as to the operations of the year because the war and the restrictions, expansions and other changes growing from it have diverted the properties in many ways from their normal practices. "Lightless" nights, "workless" days, daylight saving and the return of the clock to its old hours, coal shortage, curtailment of non-essential industries, stimulation of war industries, the nation-wide movement for economy, the higher rates received in some localities—all of these have left an impress upon the statistics.

Enough is obtainable, however, to make it certain that the gross business of electric utilities has continued to make a very satisfactory showing. Business was not conducted by any means as usual during the year. The output of energy was practically commandeered by the government in active munitions-making districts, and the regular custom of developing new markets was abandoned. The great need of power, however, to meet the urgent government and civilian population requirements assured an output which represented in many communities the full plant capacity.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Industry Represented	Revenue from the Sale of Energy			Kw.-Hr. Output		
		1917	1916	Per Cent Increase	1917	1916	Per Cent Increase
Nov.	62	$26,665,000	$23,183,000	17.0	1,485,370,000	1,292,113,000	15.7
Dec.	58	28,144,000	25,026,000	12.4	1,517,001,000	1,362,299,000	11.0
		1918	1917		1918	1917	
Jan.	62	27,035,000	24,977,000	8.2	1,508,353,000	1,422,121,000	6.3
Feb.	60	24,690,000	22,307,000	10.6	1,254,217,000	1,168,288,000	7.1
Mar.	60	25,396,000	22,702,000	12.3	1,418,222,000	1,294,561,000	9.4
Apr.	60	25,864,000	22,966,000	12.6	1,450,221,000	1,297,843,000	11.5
May	62	25,365,000	22,426,000	13.1	1,537,527,000	1,372,935,000	11.9
June	60	26,070,000	22,599,000	15.3	1,531,099,000	1,319,444,000	16.0
July	56	21,935,000	18,559,000	18.2	1,370,461,000	1,156,692,000	18.5
Aug.	61	26,891,000	22,690,000	18.5	1,647,510,000	1,417,150,000	16.3
Sept.	60	28,051,000	23,810,000	17.8	1,579,149,000	1,348,820,000	17.0
Oct.	54	22,848,000	20,161,000	13.3	1,257,263,000	1,142,559,000	10.0

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	New England States				Atlantic States				Central States				Pacific and Mountain States			
		Percentage of Industry Represented	1917	1916	Per Cent Increase	Percentage of Industry Represented	1917	1916	Per Cent Increase	Percentage of Industry Represented	1917	1916	Per Cent Increase	Percentage of Industry Represented	1917	1916	Per Cent Increase
REVENUE	Nov.	64	$3,391,000	$2,834,000	19.7	65	$10,159,000	$8,873,000	14.5	52	$8,454,000	$7,063,000	19.7	84	$4,661,000	$4,410,000	5.9
	Dec.	64	3,483,000	2,999,000	16.1	58	10,834,000	9,949,000	8.8	48	8,935,000	7,464,000	19.7	82	4,892,000	4,614,000	0.6
			1918	1917			1918	1917			1918	1917			1918	1917	
	Jan.	63	3,393,000	2,990,000	13.8	64	9,677,000	9,517,000	1.6	53	8,862,000	7,639,000	16.8	86	5,113,000	4,831,000	5.8
	Feb.	62	2,995,000	2,272,000	8.0	57	9,473,000	8,658,000	8.6	53	7,779,000	6,746,000	15.3	84	4,443,000	4,131,000	9.5
	March	62	2,985,000	2,724,000	9.2	59	9,904,000	8,922,000	11.0	53	7,947,000	6,735,000	18.0	84	4,560,000	4,321,000	5.5
	April	62	2,890,000	2,578,000	12.1	59	10,054,000	8,946,000	12.4	53	8,431,000	7,103,000	18.7	84	4,489,000	4,339,000	3.5
	May	62	2,810,000	2,530,000	11.5	64	9,929,000	8,613,000	15.3	53	8,217,000	6,956,000	18.1	83	4,805,000	4,327,000	12.0
	June	63	2,925,000	2,584,000	13.3	63	10,048,000	8,761,000	14.7	49	8,124,000	6,824 000	19.0	84	4,973,000	4,432,000	12.2
	July	62	3,037,000	2,511,000	20.9	62	9,278,000	7,961,000	16.5	42	4,998,000	4,116,000	21.4	88	4,622,000	3,971,000	16.4
	Aug	63	3,138,000	2,585,000	21.4	63	10,147,000	8,722,000	16.3	51	8,223,000	6,823,000	20.5	85	5,383,000	4,560,000	18.0
	Sep.	64	3,268,000	2,811,000	16 2	57	10,143,000	8,631,000	17.5	51	9,251,000	7,703,000	20.1	86	5,389,000	4,665,000	15.5
	Oct.	63	3,360,000	3,036,000	10.6	52	7,695,000	6,872,000	11.9	44	7,639,000	6,512,000	17.3	77	4,154,000	3,741,000	11.0
KW.-HR. OUTPUT			1917	1916			1917	1916			1917	1916			1917	1916	
	Nov.	64	130,311,000	108,561,000	20.0	65	532,301,000	445,537,000	19.6	52	443,374,000	384,480,000	15.2	84	379,384,000	357,535,000	6.1
	Dec.	64	135,703,000	111,342,000	21.8	58	548,316,000	486,368,000	12.7	48	437,264,000	367,534,000	12.8	82	395,518,000	377,058,000	4.8
			1918	1917			1918	1917			1918	1917			1918	1917	
	Jan.	63	125,212,000	111,339,000	12.4	64	477,200,000	466,158,000	2.3	53	486,291,000	453,009,000	7.3	86	419,651,000	391,624,000	7.3
	Feb.	62	110,454,000	102,562,000	7 7	57	438,721,000	403,122,000	8.3	53	358,276,000	342,257,000	4 5	84	346,766,000	320,025,000	8.4
	March	62	121,518,000	111,576,000	8.9	59	501,320,000	452,250,000	10.8	53	398,166,000	356,860,000	11.5	84	397,218,000	373,875,000	6.2
	April	62	117,416,000	101,888,000	15.2	59	497,460,000	431,786,000	15.2	53	437,054,000	392,304,000	11 4	84	399,126,000	372,465,000	7.1
	May	62	121,751,000	105,601,000	15.3	64	512,202,000	455,977,000	12.3	53	441,202,000	404,560,000	9.0	83	462,372,000	406,797,000	13.6
	June	63	125,809,000	103,292,000	21.8	63	527,773,000	461,396,000	14. 4	49	423,439,000	366,382,000	15.5	84	454,078,000	388,374,000	16.9
	July	62	135,960,000	105,373,000	29.0	62	518,566,000	439,464,000	18.0	42	254,189,000	216,296,000	17.5	88	461,746,000	395,559,000	16.7
	Aug	63	143.566,000	114,017,000	25.9	63	567,672,000	490,505,000	15.7	51	447,829,000	399,278,000	12.1	85	488,433,000	413,350,000	18.1
	Sept.	64	133,901,000	114,279,000	17.1	57	520,312,000	445,154,000	16.8	51	471,594,000	408,320,000	15.5	86	453,342,000	381,067,000	18.9
	Oct.	63	139,784,000	128,970,000	8.3	52	346,090,000	311,749,000	11.0	44	403,202,000	368,198,000	9.5	77	368,187,000	333,642,000	10.3

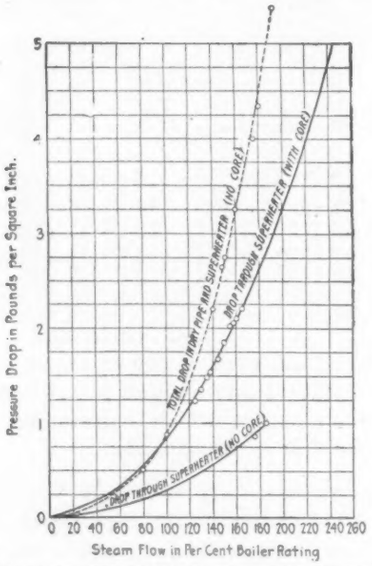
STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

PRESSURE DROP IN DRY PIPES AND SUPERHEATERS

Lower Losses with Open-Tube Superheater—Drop Increased by Suspended Matter in Boiler Water—Tests Made in Detroit

While the pressure drop through the dry pipe and superheater of a boiler is not noticeable at low ratings, the rapid increase in pressure loss (proportional to square of rating) as the boiler rating increases makes this point one which should be watched. It is usually at the time when high ratings must be developed on the boilers that the need is felt for the maximum steam pressure, and a loss in pressure means a decrease not only in efficiency of operation but in the capacity of the prime movers.


Pressure Drop in Pounds per Square Inch.
0
1
2
3
4
5
0 20 40 60 80 100 120 140 160 180 200 220 240 260
Steam Flow in Per Cent Boiler Rating
TOTAL DROP IN DRY PIPE AND SUPERHEATER (NO CORE)
DROP THROUGH SUPERHEATER (WITH CORE)
DROP THROUGH SUPERHEATER (NO CORE)

RATIO OF STEAM FLOW TO PRESSURE DROP

When the boiler-feed water contains much matter in suspension it may be carried over into the dry-pipe holes, superheater, valves and even the blades of the turbines, especially during heavy loads, restricting the steam passages and increasing the pressure drop. Thorough washing of the passages whenever the boiler is down for cleaning helps considerably, but the only real remedy is to treat the make-up water.

A summary of a few tests on pressure drop through dry pipes and superheaters follows:

At the Detroit municipal lighting plant the total pressure drop through the superheater and dry pipe on a 685-hp. Stirling boiler at 189 per cent rating amounted to 20.40 lb. (1.5 kg.). At 100 per cent rating the pressure drop was 5.7 lb. (399 gm.).

On a test at the Brunots Island plant in Pittsburgh on an 800-hp. Stirling boiler at 200 per cent rating a pressure drop was noted of 3.5 lb. (245 gm.) through the dry pipe and an additional drop of 4 lb. (280 gm.) through the superheater.

At the Water Street station at Toledo on a 670-hp. Stirling boiler with cored superheaters the pressure drop through the superheater at 165 per cent rating was 2.2 lb. (140 gm.); at 100 per cent rating this would be 0.8 lb. (56 gm.). On another test at the Water Street station on a 670-hp. Stirling boiler with an open-tube superheater the drop through the superheater at 185 per cent rating was 1 lb. (70 gm.) and through the dry pipe 3.9 lb. (270 gm.). At 100 per cent rating this would mean a drop of 0.3 lb. (21 gm.) through the superheater and of 0.6 lb. (42 gm.) through the dry pipe.

The foregoing information was given by George M. Coughlin, assistant results engineer of the Toledo Railways & Light Company.

ELECTRIC RIVETING FURNACES FOUND HIGHLY SUCCESSFUL

Tests Show that Costs Compare Favorably with Costs of Gas Without Taking Into Consideration Superiority of Product

Last winter, when a gas shortage seemed inevitable, H. P. Smith, power engineer for the McClintic-Marshall Construction Company, Pittsburgh, Pa., made an investigation to discover if possible a substitute for natural-gas-fired rivet-heating furnaces. The tests which were made included a test of an electric furnace. According to statements on this test made by Mr. Smith before the Engineers' Society of Western Pennsylvania, the cost of heating with electricity compared favorably with that of natural gas, the prices of both classes of service in that district being somewhat lower than those usually found. In figuring these comparative costs no consideration was given to improvement in the product, which is a decided feature in favor of the electric furnace.

The thermal efficiency of the furnace when heating rivets is only about 50 per cent. This is low on account of the fact that the furnace door is opened frequently. The same furnace used for heat-treating steel or melting non-ferrous metals would probably reach a thermal efficiency of 90 per cent or more. The furnace which was used is of the Bailey type, measuring 6 ft. long, 30 in. wide and 18 in. high (1.8 m. by 76 cm. by 45 cm.). It has three doors at the front and is capable of heating every fifteen minutes seventy rivets weighing 45 lb. to the proper temperature for driving. This operation requires 40 kw. The heating element used is graphite, the loss due to oxidation amounting to about 30 per cent per ton of metal treated for rivet heating.

SELECTION OF METERS TO GIVE PLANT RECORD

What One Ohio Company Considers Adequate Metering Equipment to Give Accurate Check on Plant Operation

In both the mechanical and electrical ends of the new power plant of the Mansfield (Ohio) Electric Light & Power Company special attention has been given to the selection of metering equipment. Arrangements have been made so that the station attendants have practically no readings to take. Moreover, the equipment permits the detection of the slightest inefficiency in the plant and enables the engineers to trace the inefficiency to its source.

In the boiler-room coal is weighed as it goes to the boilers on Richardson patent automatic scales of the stationary type. Gas, which is also used as fuel, is measured too. Each boiler is equipped with a Bailey boiler efficiency meter, recording steam flow, air flow and flue-gas temperature. The instrument also has a firebox draft indicator. There is a Columbia recording superheat thermometer of the Schaeffer & Budenberg type to assist in adjusting the baffling. A recording flue-gas temperature meter affords another check on the baffling. Water is measured by a recording and integrating meter, which besides measuring volume also takes the temperature of the water at the feed-water meter. Recording steam-flow meters of the Bailey type will be placed on each turbine to indicate the steam flow, steam pressure and superheat. At the condenser a meter is installed to indicate the temperature of the exhaust from the turbine, the temperature of the injection water and the temperature of the water discharged, all on one chart.

On the electrical end, in addition to all the common switchboard instruments, the plant will contain a totalizing panel with a recording watt-hour meter and recording voltmeter. With this equipment it is believed that an accurate check on the plant operation can be kept.

TEST DATA TAKEN ON 6000 SAMPLES OF INDIANA COAL

Information on Coal Which Is of Value as Supplementing Similar Data Already Published on Coals of Other Regions

About 6000 samples of coal from forty-six points of shipment in Indiana have been analyzed by the Indianapolis Light & Heat Company. The different kinds of coal tested include mine-run, screenings, nut and 1¼-in. lump. The analysis which this company has made includes seventy-six different groups of averages for the different kinds of coal from different locations. The tests show moisture content ranging all the way from 9.46 to 17.3. Volatile carbonaceous material ranges from 25.81 to 40.5. Fixed carbon values vary from 42.3 to 60.36. The percentage of ash is as low as 4.2 and as high as 28.6. The sulphur content ranges from 1.55 to 7.6 with the exception of coals for which no values are shown. All of the coals are above 10,000 B.t.u. in heating value, some going as high at 13,488 and as low as 10,310.

Similar information for all parts of the country has been published by the National District Heating Association, the Illinois Stoker Company and the Bureau of Mines, but the information collected by the Indiana company is particularly complete for that state. Since the variation in quality of Indiana coal is unusually large, T. N. Wynne, who recently presented these data before the Indiana Electric Light Association, urges that care be used in selecting coal that is best suited to operating conditions.

TESTS ON INDIANA COALS

No.	Point of Shipment	Kind	No. of Samples	Moisture	V.C.M.	F.C.	Ash	Sulp.	B.T.U.'s
1	Ayredale	Scgs. No. 4	63	14.9	33.5	58.7	7.8	1.74	12,807
2	Ayredale	Scgs. No. 5	6	12.78	33.36	56.95	9.69	3.95	11,789
3	Ayredale	M.R.	22	11.47	36.91	55.22	7.8	3.82	12,584
4	Bicknell	Scgs.	119	11.44	32.47	56.48	11.05	3.73	11,783
5	Bicknell	M.R.	91	11.72	33.56	56.13	10.31	3.25	12,262
6	Black Creek	Scgs.	281	15.23	33.03	57.84	9.13	2.19	12,253
7	Black Creek	M.R.	29	13.9	32.5	60.3	7.2	1.55	12,560
8	Big Vein	M.R.	1	12.1	40.5	55.3	4.2	....	13,380
9	Blackburn	Scgs.	1	11.9	....	....	12.5	....	11,800
10	Brazil	M.R.	16	12.61	33.60	48.45	17.95	5.55	11,181
11	Clinton	M.R.	10	11.9	33.49	49.91	16.6	4.25	11,699
12	W. Clinton	M.R.	7	12.0	37.9	45.5	10.6	....	12,494
13	Clovelly	Scgs.	6	12.41	....	....	17.36	....	11,711
14	Clovelly	M.R.	22	13.9	31.89	50.41	17.7	3.73	11,560
15	Coal Bluff	Scgs.	9	13.5	33.16	55.64	11.2	3.40	11,973
16	Coal Bluff	M.R.	1	13.95	37.89	54.47	7.64	4.77	12,481
17	Crown Hill	Scgs.	34	10.80	34.65	50.67	14.68	3.98	11,085
18	Crown Hill	M.R.	10	9.6	....	....	10.77	2.34	11,618
19	Dugger	Scgs.	57	13.37	34.10	58.17	7.73	2.20	11,890
20	Dugger	M.R.	1	10.7	....	....	6.1	....	11,830
21	Elberfeld	Scgs.	7	10.28	34.89	54.71	10.40	4.49	12,176
22	Essenbea	Scgs.	22	13.60	32.85	53.68	13.43	3.60	11,471
23	Essenbea	M.R.	4	11.96	33.40	51.8	14.8	....	11,215
24	S. Clinton	Scgs.	13	14.0	33.86	55.62	10.52	2.62	11,671
25	Eureka	M.R.	3	15.55	38.45	51.09	10.46	....	11,393
26	Glen	M.R.	16	13.98	31.91	55.89	12.20	3.11	12,140
27	Glendora	M.R.	33	13.5	30.98	55.52	13.5	3.15	11,860
28	Green Valley	M.R.	8	11.22	....	....	10.06	....	11,737
29	Hymera	Scgs.	2	12.7	35.25	49.85	14.9	....	11,930
30	Indian Valley	Scgs.	16	15.2	36.08	54.73	9.19	1.62	12,371
31	Indian Creek	M.R.	10	12.76	33.47	55.93	10.60	3.46	12,466
32	Island Valley	Scgs.	13	17.30	31.40	55.8	12.8	2.62	11,940
33	Island Valley	M.R.	3	16.4	....	....	11.55	3.18	11,608
34	Jackson Hill	Scgs.	2	10.37	36.16	51.71	12.13	4.34	11,230
35	Jackson Hill	M.R.	26	15.88	36.26	52.15	10.59	2.93	12,815
36	Kettle Creek	Scgs.	2	12.0	33.0	53.1	13.9	....	11,810
37	Kettle Valley	M.R.	1	12.5	33.3	54.9	11.8	....	12,160
38	Latta	M.R.	2	14.8	37.0	50.6	12.4	4.30	11,997
39	Latta	Scgs.	1	15.4	31.0	54.1	4.9	....	11,865
40	Le Noir	Scgs. No. 4	1	14.9	33.54	57.58	8.88	4.09	12,078
41	Linton	Scgs.	39	14.94	34.77	55.35	9.88	2.59	11,670
42	Linton	M.R.	34	13.38	38.28	54.11	7.61	3.23	12,134
43	Linton	Nut	1	14.10	....	....	12.3	2.30	10,550
44	Mackville	M.R.	6	11.20	33.9	52.3	13.8	3.07	11,501
45	Mackville	Scgs.	2	11.90	35.1	50.3	14.6	4.90	11,340
46	Midland	M.R.	26	12.80	34.13	49.63	16.24	3.83	11,232
47	Midland	Scgs.	11	14.20	33.47	54.85	11.69	1.75	11,527
48	Muren	Nut No. 5	7	11.73	34.79	56.88	8.23	3.56	12,209
49	Muren	Scgs.	1	14.8	28.39	58.95	12.66	3.21	11,028
50	New Goshen	Scgs.	1	12.03	35.65	50.39	13.96	4.89	13,488
51	North West	M.R.	444	14.62	33.28	58.15	8.57	2.18	12,190
52	North West	Scgs.	317	14.32	32.62	56.38	11.00	4.46	11,877
53	Paxton	M.R.	79	11.50	34.25	54.25	11.50	3.52	12,251
54	Paxton	Scgs.	22	12.19	33.31	54.94	11.75	3.42	11,696
55	Queen Valley	Scgs. No. 4	1,166	15.14	32.95	56.61	9.44	2.45	12,106
56	Queen Valley	Scgs. No. 5	754	13.50	39.07	47.03	13.9	3.71	11,551
57	Queen Valley	M.R. No. 4	502	14.68	35.98	56.39	7.63	2.14	12,518
58	Queen Valley	M.R. No. 5	188	13.69	35.14	54.35	10.51	3.17	11,854
59	Queen Valley	1½ in. Lp.	197	13.59	35.87	54.13	10.00	3.87	12,055
60	Seelyville	M.R.	3	13.81	25.81	58.34	15.85	3.78	11,433
61	Seifert	Scgs.	34	12.99	33.18	53.25	13.57	2.94	10,982
62	Seifert	M.R.	100	14.93	31.97	60.36	7.67	2.69	12,297
63	Shelburn	Scgs.	4	13.79	31.04	49.63	19.33	3.96	10,455
64	Shelburn	M.R.	2	10.93	31.72	58.55	9.73	3.11	11,331
65	Sponsler	M.R.	43	13.77	33.15	57.14	9.71	2.58	12,113
66	Sponsler	Scgs.	33	17.50	31.80	59.27	8.93	1.74	11,758
67	Staunton	M.R.	2	11.45	29.1	42.3	28.6	7.6	10,310
68	St. Clair	M.R.	2	12.35	30.70	53.4	15.9	....	10,920
69	Shirkie	M.R.	10	11.1	35.53	47.67	16.8	....	10,981
70	Shirkie	Scgs.	18	11.69	27.63	55.61	16.76	....	11,139
71	Sullivan	M.R.	6	15.24	31.10	58.20	10.70	3.97	11,867
72	Templeton	M.R.	238	11.78	34.99	52.31	12.70	4.44	11,948
73	Templeton	Scgs.	10	11.48	35.23	50.53	14.24	4.41	11,764
74	Turner	M.R.	43	11.80	31.14	51.16	17.70	5.55	11,232
75	Victoria	Scgs.	4	14.15	....	....	17.80	2.99	11,308
76	Worthington	Scgs. No. 4	1	9.46	38.89	50.87	10.24	3.48	11,892

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

PHOTOGRAPHIC EVIDENCE OF METER READINGS

Detroit Company Uses Meter Camera with Time-Taking Attachment for Readings Taken to Determine Demand Charge

The Detroit Edison Company is using a special camera for taking "load-test" meter readings to establish cusotmers' demand charge. A regular meter-reading camera was rebuilt so that now photographs are taken showing in the picture not only the meter reading but a watch dial with the time of reading and also the name and address of the customer.

The photographic readings have shown their value in a number of instances where differences of opinion have come up with regard to the correctness of load curves. For example, in a case where a customer raised an objection to his bill on the ground that readings were not taken exactly one hour apart, the production of an actual photograph of his meter with the time of taking shown on the same film satisfied him as to the correctness of the load test.

COMMERCIAL MEN SHOULD STUDY LOAD-FACTOR CONDITIONS

Long-Hour-Use Clauses in Industrial Contracts May Help to Prevent Marked Decline in Central-Station Load Factors

Many of the central stations throughout the industrial sections of the country have experienced within the last year or two a considerable increase in their load factors, due largely to the fact that consumers have been required, because of war production, to increase their output, and in many cases this has been accomplished by making further use of the equipment at hand. In certain cases plants that formerly always ran on a single-turn basis had during the war period their working hours increased to cover two or possibly three turns. Consequently the consumers' load factor has been raised from perhaps the value of 30 per cent to 60 per cent or above.

Just what dropping back in load factor central stations are to experience where they have had this wartime increase is difficult to estimate, because the war industries have not sufficiently readjusted themselves to be able to tell the extent of the operation for the next few months to come. It is probable, however, that working hours will be decreased, that the extreme pressure for production will be relieved and that load factors in many instances will fall off to a marked extent. Just how far the central station can go in keeping the load factors up during the next year is indeterminate, but the fact remains, according to C. I. Cupper of the Mahoning & Shenango Railway & Light Company, that a program calling for education of employees and consumers will produce very excellent results. In making these suggestions before the commercial men of the Ohio Electric Light Association, Mr. Cupper brought out that many central-station consumers do not fully understand the benefits to be derived by operating their plants at the best possible load factor, although practically all power rates these days are worked out in such a way as to give the man with good load factor or the long-hour user, as he is frequently termed, a materially lower rate.

This point should be brought clearly to the attention of the consumer, Mr. Cupper said, and it is quite easy to explain the situation so that he will have a very clear conception of the desirability of working in the right direction. However, the customs of the business, working hours, materials, plant equipment and many other items have considerable bearing on the question, and time and thought must be given to the subject by both the central-station company and the consumer.

In looking over station production costs there is a very interesting relationship between the cost of power and load factor at various power factors, as the cost of producing the energy increases very markedly as these two factors do. A detailed study of this relationship is very enlightening to the commercial man, and Mr. Cupper suggested that wherever possible consideration be given to this point.

SUB-METER ENERGY LOSSES REGISTERED ON MASTER METER

Central Station Must Be Prepared to Explain to Landlords Any Seeming Discrepancy in the Record

BY HALBERT R. THOMAS
Meter and Test Department, Southern California Edison Company

Large apartment houses and office buildings frequently purchase their electrical energy for lighting through a main meter, reselling to tenants through sub-meters which are either bought outright or leased from the lighting company. Such an arrangement relieves the central station of the cost of keeping many small accounts and of dealing directly with consumers whose occupancy is in many cases of a transitory nature.

If a considerable number of sub-meters are installed on a master meter, some difficulty is usually experienced in checking the consumption registered by the master meter against the total shown by the sub-meters. If all the meters are in accurate calibration, the main meter will show a slightly greater registration than the meters supplied through it. This is perfectly proper,

and the central station should be prepared to explain it to the consumer.

The modern small lighting meter consumes an amount of power in its potential coil averaging from one to two watts, effective as long as it is connected to the line and irrespective of the load current being used. Owing to the internal connections this loss is not registered by the meter, but it will be registered by any other meter placed ahead of it in the same circuit. It is obvious, therefore, that a master meter registers in addition to all energy used by consumers the sum of the potential losses of the sub-meters. This energy amounts to little per meter, but is worth considering if a large number of meters are in question.

For instance, a meter with a potential loss of 1.5 watts will consume 36 watt-hours every twenty-four hours, or 1.08 kw.-hr. per month. Fifty such sub-meters would therefore increase the consumption of the master meter by 54 kw.-hr. per month. This may not represent a large fraction of the total energy involved, but if not understood it is likely to bring a vigorous complaint from the customer landlord.

The energy supplied through the master meter is usually obtained at a quantity discount, so that its resale to the tenants will be at a profit to the landlord. He should therefore be made to see that the losses on sub-meters are a part of his operating costs and should be charged against the profits along with the cost of bookkeeping and billing.

MAKES CAPITAL OUT OF SERVICE INTERRUPTION

Central Maine Power Explains Why Lights Went Out and How Quickly Service Was Restored by Its Efforts

A service interruption on the Skowhegan distribution lines of the Central Maine Power Company was turned to good account in a recent issue of the company's monthly new bulletin to consumers, "Power," reaching about 20,000 homes a month. The accident was caused by the backing of an automobile truck belonging to a large manufacturing company into a pole of the Central Maine system, the vibration burning the wires off in nineteen places. The explanation of the interruption and the speed with which repairs were made were featured in a newsy illustrated account of the occurrence which set forth to the public the company's understanding of the inconvenience of the interruption and the efforts made to restore normal service.

The statement follows:

Once in a while the lights will go out in almost any town or city lighted by electricity. Everybody affected is irritated—and we don't blame them. But did you ever consider that it is not always the fault of the company? For instance:

In Skowhegan one day this fall an American Woolen Mill truck backed into one of the company's poles, giving it a hard push and setting the wire swaying. The vibration continued down the street and around two right-angle corners, a distance of a quarter of a mile. The vibration was so violent that the wires were thrown together and burned off in nineteen places, causing a series of electrical illuminations and explosions that startled the town and put the lights out of commission.

The Skowhegan district linemen were at Norridgewock, 6 miles away—and the auto at the wrong end of the line! Depsite that thirteen splices were made and 560 ft. of new wire put up. In fifty minutes much of the service was restored. In one and one-half hours the lights were on. The next morning the entire service was back to normal.

For a few minutes, however, the sale of kerosene hand lamps in Skowhegan established new records, and the Central Maine Power Company was as popular as the plague—and all because a big Federal truck backed some six inches too far!

DO UTILITY MEN STUDY LABOR CLOSELY ENOUGH?

Causes of Unduly High Labor Turnover May Be Discovered and Removed if Time Is Given to Examine Individual Cases

A real problem which utility operators face is that of handling labor. Recently Edward Marshall of Cincinnati made the following remarks on this subject before the station operating committee of the Ohio Electric Light Association:

Many times during the last year we would come to work in the morning and find that some who were our most faithful employees in ordinary times had not shown up. They had been offered more money elsewhere. As a consequence we have had an inferior class of labor.

Do you think most of us give our help the proper consideration and attention? Should we not have in all plants some one whose duty it is to investigate each employee's home life and the condition he labors under? Should we not know whether our help live economically and whether each man is saving a little each month? We all know that the man who is continually in debt does not make a good employee. Some system of education and relief for such an employee should be provided.

Quite a few employees have changed from one position to another in the last year, employment being plentiful, when they needed ready money for immediate and legitimate use. Owing to the fact that some companies have a hard and fast rule forbidding money to be advanced between pay days the employees who needed money had to quit to get wages that were due. This has been the cause of not a little turnover in labor. Some method of keeping in closer personal touch with employees at all times makes the employer stand better with the employees, and better general results follow. How many of us when an employee does not appear on his proper shift make it our business to know why? Do you not think efforts along this line would be repaid in better service from the employees?

ELECTRIC FURNACE SHOWS SATISFACTORY ECONOMY

Test Made by Louisville Company Shows 20 per Cent Saving in Fuel Costs and 84 per Cent Saving in Metal Loss

Recently the Louisville (Ky.) Gas & Electric Company installed an electric furnace in the plant of a manufacturer of sanitary bathroom articles. An eight-day test of the installation shows that not only was there an actual saving in money per 100 lb. of metal poured, but there was a decrease in metal loss and a fuel economy of nearly one-third.

The summary is as follows:

	Per 100 Lb. of Metal Poured With Oil	With Electricity	Improvement, Per Cent.
Cost, in cents	24	19	20
Metal loss lb.	7	1.13	84
Heating units required, B.t.u.	708,000	475,000	32

TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Calculation of the Transverse Field in the Slots of Unloaded Armatures.—L. DREYFUS.—It is first shown that the magnitude of the transverse field increases from zero under the pole centers to a maximum near the pole tips and decreases again to zero midway between the poles. This distribution round the armature at a given slot depth is worked out. The distribution of the transverse field along the depth of the slots is then calculated. The results of these investigations are expressed by rather complex differential equations. These are applied to numerical cases for straight slots and for radial slots. The calculations involved are long and somewhat complicated, but the author claims that the results arrived at are such as to permit simple and rapid calculations to be made in special cases.—*Science Abstracts, Section B,* April 30, 1918. (Abstracted from *Archiv f. Electrot.,* 6, pp. 165-224, 1917.)

Suggested Amplification of Heating Rules for Electrical Machinery.—M. VIDMAR.—It is suggested that existing rules concerning the heating of electrical machinery impose severe and unnecessary restrictions upon designers, do not accomplish their aim, and do not fully protect the purchaser. It is difficult to measure the temperatures which really determine the danger point. If the maximum (not the mean) temperature at any point in a cotton-insulated winding exceeds 105 deg. C. there is danger of burning. Rules and tests should refer to the maximum temperature, which may exist at one point only in the winding. The margin between maximum and mean temperature must not be too great, or progress is retarded and economical design is impossible. Mean temperature rise is easily measured by the increase in electrical resistance, whereas the point of maximum temperature cannot readily be determined, neither is it acessible for measurement. Clauses relating to mean temperature rise should be retained, but they should be supplemented by limiting the temperature difference between the points of maximum and mean temperature.—*Science Abstracts, Section B,* April 30, 1918. (Abstracted from *Electrot. u. Maschinenbau,* Feb. 3 and Feb. 10, 1918.)

Lamps and Lighting

Rules Concerning Supply and Decay of Tungsten Lamps.—The lighting rules committee of the Union of Electricity Works has agreed with representatives of tungsten-lamp manufacturers on rules for delivery and acceptance of tungsten lamps. They apply only to vacuum lamps with plain, not spiral, filaments and to standard gas-filled lamps. Detailed rules for acceptance and rejection of lamps follow.—*Science Abstracts, Section B,* April 30, 1918. (Abstracted from *Vereinig. d. Elektrizitätswerke,* Mitt. No. 204; *Elektrot. u. Maschinenbau,* Jan. 13, 1918.)

Generation, Transmission and Distribution

Good Operating Practice in the Boiler Room.—A. E. UEHLING.—This paper was designed to demonstrate the importance of attention to the operating conditions in individual boilers in the power plant. The author says that the economical status of a boiler plant can be approximately determined by either of two methods —the mechanical one based on the heat utilized and the chemical and physical one based on the heat wasted. In the former reliance is placed on the coal weigher and the water meter or steam-flow meter; in the latter the CO_2 meter and the pyrometer are used. While both methods are necessary for complete results, the chemical and physical method gives more directly useful information. It is pointed out that there is no such thing as a fixed adjustment in the operation of a boiler. The rate of combustion must be changed to keep the steam pressure right, and the thickness of the fire must be changed to keep the efficiency of combustion (per cent of CO_2) right. As the fuel and ash bed thickens a stronger draft is necessary to keep the required rate of combustion, and there are numerous minor variables which require changes in the draft adjustments if combustion efficiency and the required boiler capacity are to be maintained; *i.e.,* maximum CO_2 and a uniform steam pressure. The author believes that the CO_2 meters, the boiler draft gage and the pyrometers, the last and first named being inserted in the main gas flue at or near the chimney, should be autographically recording in order that data may be furnished for study of operating conditions in detail. In addition to the autographic instruments an Orsat apparatus for analyzing the flue gases is essential. In order to make the general principles concrete, Mr. Uehling gave formulas for the actual calculation of the physical quantities involved in boiler operation, illustrated them by sample calculations and applied them to data of a number of boiler tests.—Paper presented before A. S. M. E. convention, December, 1918.

Hydroelectric Reconstruction at Sherbrooke.—The reconstruction work of the water-power plants owned by the city of Sherbrooke, Ohio, brought about interesting results, and a short review of the work done shows what can be accomplished in the way of raising the capacity of many existing hydroelectric plants at a comparatively small outlay and with little interruption to plant operation. After investigation the following conclusions were arrived at: (1) The turbines were inadequate in capacity and inefficient. (2) The transmission line losses were too high and the line drop excessive for satisfactory operation. (3) The crib dam at one of the plants was wasteful of water. (4) The small turbines driving the exciters of the plant were inefficient. The correction of these faults is described in detail.—*Electrical News,* Nov. 15, 1918.

Water Power in Brazil.—Of the Latin-American states there is probably none that possesses a greater wealth of undeveloped water power than Brazil, and it is the avowed intention of the government to make the most of this water power to foster the many different industries that are being developed in the republic. It is pointed out that, while the Brazilian cotton and woolen industries compete with the British, there is an excellent opening for foreign interests in financing the new enterprises. It is said that Canadian interests designed and now control the largest hydroelectric system in Brazil, namely, that on the Rio das Lages.—London *Times Engineering Supplement*, October, 1918.

Operation of Hydroelectric Plants with Irregular Loads.—A. CAUSSE and H. GOUA.—In hydroelectric plants supplying power for traction, motors, lighting, etc., although in general the total daily output of energy varies little from one season to another, the peak loads are likely to demand three times the average daily output, or even more. It is therefore necessary for these plants to standardize as nearly as possible the yearly output and to apportion the average thus obtained according to the needs of the different hours of the day. These conditions can be realized by the use of supplementary "annual" reservoirs in addition to the "daily" reservoirs. The authors examine the establishment of these reservoirs, and they give precise instructions concerning the conduit system serving the reservoirs, the surge pipes and the calculation of forced flow.—*Revue Générale de l'Electricité*, Nov. 2, 1918.

Utilization of Tides for the Production of Motive Force.—E. MAYNARD.—The author holds that the employment of the power of the tides in the coast regions of France is very important. He points out the difficulties imposed by the irregular movements of the sea and gives the result of his observations on tide levels at various ports and on the conditions existing in the coast lands which are overflowed directly by the sea or by bays, inlets, canals or the mouths of rivers. He advocates an official investigation into the feasibility and expense of the project.—*Revue Générale de l'Electricité*, Nov. 2 and 9, 1918.

The Unification of Frequencies.—U. DEL BUONO.—In view of a more rational utilization of the power of the hydroelectric plants in Italy, it would be desirable that they be connected in parallel so as to help one another during the periods of maximum demand for some of them. This mutual assistance will be of still greater importance when the great national electric power main connecting all the hydroelectric plants throughout the country is realized. It appears that the adoption of the frequency of 50 cycles or of that of 46 is the best solution of the problem, but the definitive solution will depend not only upon the technical discussion of the problem but also upon the commercial, financial and political discussion.—*Science Abstracts, Section B*, April 30, 1918. (Abstracted from *Elettrotecnica*, Feb. 5 and Feb. 15, 1918.)

A General and Quick Method for Calculating Masts.—M. SEMENZA.—In a former article (*Abs.* 802, 1917) the author has set forth a quick method for calculating a mast of square cross-section. In the present article he develops his method for rectangular-based masts. Adopting the same method as for square-based masts, a system of seven equations among seven unknown quantities is obtained, the solution of which would require a three-dimensional diagram. But, assuming that the ratio between the two sides of the pole be known, this system of equations is split off into two separate systems, each of four equations among four unknown quantities, like those for square-based poles, and these can be solved in the same manner. The method of "false position" allows, then, the finding of the value of this ratio, two or three attempts being generally sufficient to determine with good approximation the values of the sides of the pole. A practical example of the method is subsequently given.—*Science Abstracts, Section B*, April 30, 1918. (Abstracted from *Elettrotecnica*, Feb. 25, 1918.)

Current Intensities in High-Voltage Cables.—E. SOLERI.—The purpose of this article is that of setting forth the methods for determining the current intensity for high-pressure cables, taking into account the losses in the insulating substance. These for some substances, such as mica. paraffin, etc., are proportional to the square of the dielectric stress, but for other substances, such as india-rubber, impregnated paper, etc., the losses are proportional to a higher power of the dielectric stress. This fact was already known and is confirmed by the author's experiments, The temperature has a bad influence both upon the resistibility and upon the losses in the insulating substance.—*Science Abstracts, Section B*, April 30, 1918. (Abstracted from *Elettrotecnica*, Feb. 15 and Feb. 25, 1918.)

Installations, Systems and Appliances

The Heating of Houses.—It is pointed out that electric heating has advantages incident to no other system. Two main difficulties, however, preclude a very extensive use of the system, (1) the enormous amount of energy that is required (2) the high cost of electrical energy for heating as compared with other sources of heat energy. Figures are given to show that the average householder would have to pay about $357 per year for electric heating on the basis of the lowest domestic lighting rates, or even $140 on the basis of low power rates. The use of electric heating as an auxiliary to other systems for mild weather is, however, pointed out.—*Report of Hydro-Electric Power Commission of Ontario*, Feb. 28, 1918.

Notes on Electric Welding.—H. K. PORTER.—Modern locomotive specifications call for electrically welded boiler tubes and other parts, and the mechanical committees of the railroads favor the repair of bars, plates and similar pieces by the electrical process. Many other industries also recognize the rapidity with which repair work may be done by this means. The writer points out that many mining companies are wasting money, not through negligence, but because they are not thoroughly familiar with the multitude of uses to which an arc-welding system efficiently operated can be put. Some of the advantages of electrical welding are set down and some description of the equipment required for this work is also given.—*Engineering and Mining Journal*, Nov. 23, 1918.

The Improvement of Power Factor.—G. SARTORI.—The author describes the static condensers of the British Insulated and Helsby Cables, Ltd., and the Miles Walker phase-advancing machine. Of the latter an elementary

calculation is given in order to find out its fundamental dimensions. The improvement of the power factor of electric lines is of such importance that at this moment the problem of taking it into account when charging for energy is being discussed by several electrical associations of the world. The author agrees with Boucherot in the view that the price of energy must be proportional to $A \times VI \cos\varphi + B \times VI \sin\varphi$ and not to $A \times VI \cos\varphi + B' \times VI$, as proposed by Arno.—*Science Abstracts, Section B*, April 30, 1918. (Abstrated from *Elettrotecnica*, Feb. 25, 1918.)

Large Generating Stations.—M. SEIDNER.—The author considers in detail the composition of total energy costs and gives general curves and formulas for the variable and total costs in any particular case. With increasing load factor the total cost per unit decreases hyperbolically toward the "fuel cost," whereas at low load factor fixed charges are of chief importance and fuel costs may almost be neglected. The advantage of large compared with small generating sets in point of lower first cost per kilowatt is well known, and the author gives typical data illustrating this point. Labor costs per unit may be twenty times as great in a small station as in a large one. Some reserve plant is essential, but the proportion may be lower and the plant factor therefore higher in a large station than in a small one. A large station can accept all industrial loads, whereas a small station dare not connect loads exceeding a fraction of its own plant capacity. The problems of cheap coal supply and the possible operation of a private colliery are best solved by a large station. Whereas the thermal efficiency of a small hand-fired boiler rarely exceeds 50 to 60 per cent, that of a large boiler with machine stoking may be 83 per cent. Finally the steam consumption of a 50,000-hp. turbine is about 5 kg. per kilowatt-hour, compared with 10 kg. per kilowatt-hour of a 500-hp. machine. A detailed numerical example is given comparing stations with a 300-hp. crude-oil engine and a 9000-hp. steam turbine respectively. It is concluded that the total cost of energy is five times as great in the smaller station, which has principally a lighting load, as in the larger station, which serves a large number both of small and large motors.—*Science Abstracts, Section B*, April 30, 1918. (Abstracted from *Elektrot. u. Maschinenbau*, Jan., 6 and Jan. 13, 1918.)

Electrophysics and Magnetism

Electric Resistance of Porcelain at Different Temperatures.—R. G. ALLEN.—The resistance of eight samples of porcelain was investigated up to about 250 deg. C., three methods of measurement being employed. These involved the use of (a) a megger, (b) a high-resistance galvanometer, (c) a 0.005-mfd. condenser, the rate of leakage of which was determined by a Kelvin multicellular electrostatic voltmeter. Over the limited temperature range investigated it was found that the specific insulation resistance d and the absolute temperature T were related by the formula $\log d = a/T + b$, due to Rasch and Hinrichsen. a and b are constants for the material under consideration, and the author suggests that these may serve to identify the origin of the porcelain.—*Science Abstracts, Section B*, September, 1918. (Abstracted from *Royal Dublin Society Proceedings*, June, 1918.)

Electrochemistry and Batteries

Products of the Electric Furnace and the Electrolytic Cell.—At the recent Chemical Exposition a chart was exhibited in the booth of the American Electrochemical Society portraying the production of the electric furnace and the electrolytic cell. This chart was compiled by Dr. C. G. Fink. It showed some thirty-three products together with the raw materials from which they were made as well as the applications which they have found in the industries.—*Chemical and Metallurgical Engineering*, Dec. 1, 1918.

Telegraphy, Telephony and Signals

Increasing the Efficiency of Telegraph Lines.—O. SRNKA.—The present paper deals very completely with the transmission of high-frequency currents over line wires, and the usual equations are established. A comparison of impedance variations with frequency of various iron and copper wires is given. The author also investigates at length the alteration in the line constants—*i.e.*, capacity, inductance, leakage and resistance—over a range of frequencies between 200 and 1200 cycles per second for bronze and steel aerial wires and telephone cable. The current intensities for different frequencies in various classes of line are also investigated. The purpose of the investigations is to find the best conditions necessary for a form of multiple telegraphy based on differentiation by frequency, selection being accomplished by mechanical resonance.—*Science Abstracts, Section B*, April 30, 1918. (Abstracted from *Elektrot. u. Maschinenbau*, Dec. 30, 1917.)

Thermionic-Valve Slope Meter.—E. V. APPLETON.—According to Latour's definition of amplifying power, it can be shown that maximum amplification is obtained with a thermionic valve when the extra plate circuit resistance has a value equal to the reciprocal of the slope of the plate-voltage, plate-current curve. Means of obtaining experimentally the characteristic curve from which the slope may be obtained are outlined in this article.—*Wireless World*, November, 1918.

Miscellaneous

Employment of Discharged Soldiers.—Considering particularly the character of discharged soldiers who have not been seriously mutilated and who have not lost their eyesight, the use of these men in industry has not been altogether successful. It is pointed out that the experience in the army is such that the men have been accustomed to some form of amusement and recreation while not in the trenches, and it is hard for them to settle down to a monotonous job. It is said that some constructive educational scheme should be adopted whereby these men might be interested in their occupations or diverted to some other work in case the first attempt is unsuccessful.—London *Times Engineering Supplement*, October, 1918.

Empire Water-Power Development.—Owing to the fact that water-power development has not been extensive on the British Isles, the training of engineers for undertaking large hydroelectric developments has not been adequate. But owing to the present and prospective hydroelectric possibilities in the British colonies it is proposed that this deficiency in the training of engineers in England should be quickly remedied.—London *Times Engineering Supplement*, October, 1918.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

END OF WAR COMMITTEE OF TECHNICAL SOCIETIES

Report of D. W. Brunton, the Chairman, Reviews the Work Done by the Organization, Representing Many Technical Societies

A report of the activities of the War Committee of Technical Societies, by D. W. Brunton, the chairman, reviews the work from its organization on June 27, 1917, to its termination on Dec. 31.

That the war committee should cover as broad a field as possible and afford full facilities to the technical men of this country to utilize their inventive talent for the benefit of the government, membership in this committee was not restricted to the four great national societies, but other technical organizations were invited to join, with the result that the committee now consists of two members from each of the following societies: The American Institute of Electrical Engineers, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers, the American Electro-Chemical Society, the Mining and Metallurgical Society of America, the Illuminating Engineering Society, the American Gas Institute, the American Society of Refrigerating Engineers, the American Institute of Chemical Engineers, the Society of Automotive Engineers, and the American Society of Heating and Ventilating Engineers. The American Chemical Society also coöperated, and the officials of the committee, in addition to the chairman, Mr. Brunton, were: Vice-chairman, Edmund B. Kirby; secretary, Capt. Lloyd N. Scott; treasurer, Preston S. Millar.

The report says in part:

The General Staff of the army offered to aid us by appointing a liaison officer who should be free to devote half his time to war committee work.

After due consultation with the chairman and the secretary of the Engineering Council, this offer was accepted, and Capt. Lloyd N. Scott of the inventions section of the General Staff was appointed liaison officer to the war committee and at a meeting of the board held in New York on Sept. 10 he was elected secretary. This arrangement has proved most satisfactory to the army, the Naval Consulting Board and the war committee, as Captain Scott is a staff officer with a wide experience in engineering and business undertakings, which, combined with forcefulness and tact, has made it possible for him to achieve wonderful results under conditions such as now exist in Washington.

The war problems received from the army and navy may be grouped into three classes: (a) Those which are suitable for general distribution to our members by means of bulletins and letters; (b) semi-confidential problems which are sent to selected individuals and groups of inventors who are known to be interested in that particular class of work; (c) strictly confidential problems, the solution of which requires the highest order of technical information and which can be sent only to carefully selected scientists and prominent inventors whose life study has fitted them for the work in hand.

These problems are always mailed in double envelopes, the outer one giving no trace of its contents and the inner envelope marked "private and confidential." At present the outstanding problems in Class C relate principally to submarine detection devices, aëroplane instruments, especially those required in cloud and night flying, and liaison devices for communication between the advancing front of an army and the artillery at the rear.

The war committee, in sending out both bulletins and letters, requested our members to forward all ideas, suggestions and inventions on naval warfare to the Naval Consulting Board, and on land warfare to the inventions section of the General Staff. The material received in response to our bulletins and letters ranged from aëroplane supercharges and fuel for high-altitude flying down to submarine detectors and depth bombs, from long-range guns to trench knives, from observation balloons to tunneling machines, and from caterpillar tanks to radium sights.

Up to date, more than 110,000 ideas, suggestions and inventions have been received and passed upon by the Navy Department and the Naval Consulting Board, either separately or conjointly, and the inventions section of the General Staff, which is a much younger organization, has already handled over 25,000. The crest of the inventions wave for the Navy Department and the Naval Consulting Board was reached in the early months of the war, when the receipts amounted to as high as 600 per day, and that of the inventions section of the army in July last, when they reached 124 per day. All the material received by both organizations is subjected to careful study.

In its financial relations the committee has been singularly fortunate, as, owing to the generous support given by the Navy Department, the Naval Consulting Board and the inventions section of the General Staff, it has expended only $1,843.01 of the $4,700 appropriated by the Engineering Council, and all of the funds contributed by organizations not included in the four founder societies are still intact in the hands of the treasurer.

The great war which has just been brought to such a glorious conclusion has given us all a realization of the dangers of inadequate preparation for national defense. In no department has this been felt so severely as in the scarcity of engineering officers and the ignorance of military affairs on the part of those that were obtainable. To benefit by past experience we must insist that in every engineering school the students shall have a thorough military training. The last war and the wars in future will be engineers' wars, and it is to the engineers that the country must look for officers to supplement the efficient, highly trained but numerically inadequate supply graduated from West Point and Annapolis.

Now that the war is over, the government can scarcely expect continuous volunteer service from our members, and after consultation with all of the parties at interest it has been decided that though the engineers of this country still maintain their readiness to assist the government in every possible way, it will be more economical and convenient for the army and navy to function with the members of the societies which united to form the War Committee of Technical Societies through the secretaries of these organizations. For this reason the Engineering Council has asked that the committee be dissolved on Dec. 31, at which time our appropriations will cease.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Annual Convention at Baltimore Discusses a Wide Range of Topics—Dr. Drinker on Conservation of All Resources

The American Association for the Advancement of Science held its annual convention in Baltimore during Christmas week, most of the meetings taking place between December 26 and 28.

The engineering section met on the afternoon of Dec. 26, and the retiring vice-president of the section, Dr. Henry S. Drinker, president of Lehigh University, gave an address on "The Need of Conservation of Our Vital and Natural Resources as Emphasized by the Lessons of the War."

DR. DRINKER ON CONSERVATION

Dr. Drinker said that the war has, in transportation and in national industry, taught and enforced on our nation, quick to learn, lessons of waste in the past and of future economic management by joint coöperative effort. Of all the lessons of conservation of our resources taught by the war, those of needed coöperative effort in our railroad and industrial interests are perhaps the most prominent and important in a material sense, and the lesson has been one not only to and for the public and our national and state authorities, but one by which those interests are benefiting in a direct manner.

While, as a war measure, the temporary possession and operation of our railroads by the government was necessary, the continuance of such a system in peace, or of any measure of government ownership with its political evils, Dr. Drinker declared, would be a calamity depriving the traveling public of the efficient operation naturally coming from the initiative and enterprise and sense of responsibility attending individual management, and always absent where governmental red tape and autocratic authority rule regardless of the comfort or needs of the public.

Some reasonable, responsible governmental oversight or control of these great interests is without doubt necessary. The war urgency, the more intimate relations that war needs have established between governmental agencies and railroad and industrial managers, must and will lead to the establishment of systems of regulation not destructive but constructive in character, that will operate to the lasting benefit of our country.

The need of conservation and development of our latent water-power resources has been emphasized by the war, continued Dr. Drinker. Serious differences of opinion have existed in the past as to the proper measure of governmental control that should be exercised in the development and use of the great latent water powers of the West, and enabling legislation has been impeded and halted by visionary and wholly unpractical objections to such reasonable and liberal legislation as would encourage capital to enter into and support such development. As a wise Westerner has said of the development of the West in the past, "The western country was never settled, and never could have been settled, with thirty cents and an infant class," and conservation of our natural resources was well defined by Dr. C. W. Hayes, when chief geologist of the Geological Survey, as "utilization with a maximum efficiency and a minimum waste."

One great lesson in conservation peculiarly applicable to our nervous, energetic and always hard-working people which we have not yet adopted, because we are so constituted that as a nation or a race we will not learn it, is that of the better conservation of our vital resources.

The trouble with most of the plans for railroad and business regulation and for mineral and water-power conservation proposed by men untrained and inexperienced in engineering and in business and financial methods and problems, said the speaker, is that their plans are apt to be ideal rather than real, their dicta negative and destructive rather than affirmative, positive and constructive, and their remedies untried and theoretical experiments rather than of practical and efficient effect.

In his concluding remarks Dr. Drinker said that we should recognize, and this great war's awakening and upturn of all preconceived and preëxisting conditions have emphasized, the importance of businesslike rather than political management of our national transportation and industrial interests and of all other national affairs involving expert scientific or business knowledge and training. Our country owes an incalculable debt of gratitude and appreciation to the great interests that have led in and made possible the wonderful transportation and industrial development of our land, and we may find that on a large scale we will be killing the goose that lays the golden egg of national prosperity if we suffer our railroads and our great industries to be nagged and oppressed to the point of possible insolvency by blind unreasoning prejudice largely born of ignorance and largely based on political considerations that should not control.

C. R. Dooley of the committee on education of the War Department spoke on "Intensive Training," describing the system of vocational training for soldiers in operation in more than 100 American colleges during the past year. His paper was in substance the same as that read by him at the annual meeting of the American Society of Mechanical Engineers last December. A lively discussion followed this paper, mainly on the incentive which made each soldier achieve so much in a short time. The consensus of opinion was that these young men were primarily prompted by patriotism and by a clear understanding of the importance of engineering in the war. Various opinions were expressed as to how similar training could be carried on just as intensively in peace times.

Dr. Henry G. Reist's paper on "A New Principle Used in the Design of Large Bearings" was read by title.

MANY ENGINEERING TOPICS DISCUSSED ON SATURDAY

The second meeting of the engineering section took place on Saturday morning, Dec. 28. William L. De Baufre read a paper on "The United States Naval Engineering Experiment Station," in which he described the equipment and the tests on machinery and materials performed for the Steam Engineering Bureau of the navy. F. J. Trumpour read a paper on "Hydraulic Tunneling," in which he described his new device combining the usual shield system with cutters and suction used in hydraulic dredges.

Dr. J. B. Whitehead of Johns Hopkins University regretted that he was not in a position to give the results of his research done for the army during the past year and reviewed his experiments on the corona voltmeter which have been described in previous years.

F. A. Halsey, the secretary of the American Institute of Weights and Measures, read a paper on "The Metric System Used in Engineering." The institute which he represents is opposed to the metric system, and he gave examples of difficulties which would arise if computations were performed in the metric system while the available materials are all made to dimensions in inches. Several members present disagreed with the speaker and pointed out not only the advantages but the inevitability of the metric system if this country is to retain a commanding position in the world's markets.

The meetings of the physics sections held in conjunction with the American Physical Society were interesting and spirited as usual. One noticeable feature of the meetings was the large number of papers from industrial laboratories and from government bureaus as compared with only a few papers from college professors. This fact is probably due to a feverish activity in all industrial laboratories upon war problems, while the colleges were depleted of their scientific personnel and had to devote their whole energy to the training of student soldiers. The Bureau of Standards led with three papers on glass and its properties. There has been considerable interest manifested in the production of high-grade glass for optical purposes since the supply from Germany has been cut off. Two papers were presented by the Bureau of Standards on photoelectric sensitivity and two others on topics more remote from applied electricity. Three papers were presented from the Nela Laboratory, on optics, on pyrometry and on energy distribution in spectra. Three papers were from the Westinghouse Research Laboratory, two of which were on hot-wire anemometer and on thermal conductivity of important materials used in the manufacture of electrical apparatus. Papers were also read by members of the staff of the United States Weather Bureau and other bodies.

The comparatively young Optical Society of America met for the third time, showing a healthy growth and a tremendous development of the glass industry, due to the war. Of particular interest was a symposium on applied optics, with special reference to the future of the optical industry in this country. The topics discussed were optical glass, photographic cameras, projection apparatus, photometric apparatus, special-research apparatus and illuminating engineering. The needs were also emphasized for education and training, for scientific control in manufacturing and for testing and research.

The American Metric Association had a very successful and well-attended meeting under the guidance of its president, Dr. George F. Kunz of Tiffany & Company. Part of the meetings were held jointly with the section on social and economic science, to emphasize the economic value of metric weights and measures. Representatives from the American Chemical Society, from the Wholesale Grocers' Association and from the Druggists' Association also voiced their conviction in favor of the metric system. A very successful metric dinner and victory celebration was held at the Southern Hotel. William C. Redfield, Secretary of Commerce, gave the main address, in which he expressed his conviction that the metric system must ultimately prevail in this country. Senator Shafroth of Colorado read the bill which he has introduced into the United States Senate to make the metric system obligatory in all government contracts after a certain date.

One of the sessions of the section on psychology was devoted to mental testing and psychological examining in the United States Army, also on the relation of intelligence to occupation as indicated by army data. It is thought that much of this work will be found useful in peace industries after the war and that the methods and tests developed will help to place men and women in occupations for which they are best adapted.

RE-EMPLOYMENT OF MEN IN NATIONAL SERVICE

President E. W. Rice, Jr., of General Electric Company, Says It Is First Duty to Provide for Those Who Served Country

A letter sent by President E. W. Rice, Jr., of the General Electric Company to all departments on the subject of reëmployment of men in the service follows:

It has been a matter of great pride to us all that nearly 8000 of our men left the company's employ to enter the military or naval service of our country. Many of them will return to us in the near future and we shall welcome them home with deep pleasure. After consultation with the executive officers and factory managers, it has been decided that:

Those who return from military or naval service and who apply for reinstatement will be placed if possible in positions in the department, office or works that they left in order to enter the service. Such reëmployment is to be limited to men who have been honorably discharged from military or naval service and, except in special cases, who apply for reëmployment within sixty days from the date of such discharge.

Those who return direct from military or naval service to the company's employ, without accepting employment elsewhere, will be given credit for continuity of service in the company's employment record, including the length of time spent in military or naval service as if they had worked continuously for the company during that period.

Compensation of men so reëmployed shall be the current rate paid to employees engaged in similar work at the date of reëmployment. The reëmployment of men disabled in military service will be directed by committees to be appointed. It is obvious that in anticipation of the above care should be taken to avoid, as far as possible, the employment of additional help or the replacement of employees who may leave.

The company has been asked to cancel certain orders for large amounts and to suspend work on other orders, and a further reduction during the next few months is probable. These conditions may make it difficult to provide full-time employment for all of our present forces, but in order to keep as large a proportion as possible at work, our managers are asked to coöperate with our employees as follows: Those who have recently come to us from other places or occupations should be encouraged and aided to return to the work in which they were engaged before the war, or they should receive our hearty cooperation in finding other satisfactory work.

We shall do the best we can for all, but we are confident that our entire force will share the view that it is our first duty to provide employment for the men who gave up their positions in order to serve their country.

A NEW INTERNATIONAL ENGINEERING PERIODICAL

McGraw-Hill Company to Publish on March 1 in Spanish "La Ingenieria Internacional," with Editions in Several Languages Later

Realizing the value of the international exchange of ideas on things engineering, the McGraw-Hill Company on March 1 will begin publication of a magazine dedicated to that purpose. While eventually it is expected to appear in editions in several languages, the original issue will be in Spanish, under the name *La Ingenieria Internacional*, aimed to serve Latin America and Spain.

The purpose of the new magazine, which has been under consideration for some years, is to afford a medium for the presentation of those developments in American engineering which may be of value to engineers, contractors and manufacturers in other lands. At the same time, following the practice of the present McGraw-Hill publications, a far-flung editorial organization will be developed, so that there will be drawn into the paper the best of engineering practice in Latin America, Spain and other Spanish-speaking countries. Aside from this function, the new magazine will be an important developer of international good will and at the same time a medium by which American manufacturers engaging in expert trades can carry their message to prospective buyers in foreign lands.

It may be a cause of surprise that the McGraw-Hill Company, whose specialized papers circulate so widely overseas, should establish a magazine to serve the foreign field. The reason, however, is not hard to find. The present highly specialized papers appeal only to those who are situated where engineering enterprise has made such progress that there is room for the specialist and need for the last refinement in equipment and design. But everywhere the world over are territories newly developing where the engineer, the contractor or the manufacturer must turn his hand to many lines. It is to serve the general practitioner so situated that the new magazine and its later companions in other languages will be started.

The specialized papers in English will still hold their place as the recorders of the best in the advanced practice of American engineering.

BYLLESBY REVIEW OF UTILITY CONDITIONS

Rate Increases in Majority of Companies Maintain Position of Properties, but Net Revenues Show Slight Reduction

H. M. Byllesby & Company in issuing their brief annual review of the general situation affecting electric and gas service companies disclaim any intention to speak for these industries as a whole and confine their remarks to the companies directly under their own management.

It appears that the utility companies under Byllesby management, serving upward of 400 cities and towns, with a population of more than 2,000,000, in sixteen states, went through the second year of the war, rendering vastly more service to public and industry than ever before, with practically stationary net earnings, but at the same time maintained bond interest and preferred stock dividends. In a number of cases dividends on common stock were reduced or discontinued.

Electric service companies were exceedingly important factors in the industrial stimulation necessary to win the war. Demands for additional electric energy at many points were imperative either to render service to war and essential industries or to conserve fuel. This meant that construction had to proceed despite every handicap. Upward of 66,000 hp. in steam-turbine units, 254 miles of high-voltage transmission line and many other additions had to be financed and installed.

This unavoidable construction, with certain maturing obligations, made necessary financing amounting to approximately $24,500,000 par value in bonds, notes and preferred stock. The new bonds issued totaled $14,569,000, coupon notes $7,953,300 and preferred stock about $1,900,000.

Byllesby & Company accomplished this financing with the assistance of a number of investment banking houses and through their own bond department, without government aid. New preferred stock and bonds and notes sold locally or in territories where the companies operate amounted to more than $4,500,000.

In the face of the unprecedented price levels and wage standards it was necessary for the majority of the operating companies to place in effect higher rate schedules for service. This was accomplished in the great majority of cities with the friendly coöperation of the public, which recognized the fact that in the past rates had been reduced when operating expenses were low.

The effect of these rate increases enabled the companies to continue good service, maintain credit, perform necessary financing and make the extensions and additions necessary to war production and public welfare. How far short they fell of enabling anything approaching "profiteering" may be judged from the following:

During the year ended Oct. 31, 1918, the Byllesby properties delivered 20 per cent more service to the public than during the preceding twelve months. For this service the properties received a total gross revenue of $22,437,432, which represented an increase of $3,653,382, or 19.4 per cent, over the previous year. Here was a large increase in service and a large gain in gross earnings, but advanced operating expenses and taxes actually reduced the aggregate net earnings by $2,463. During the latter quarter of the year 1918 an improvement in net earnings was made, and it is apparent that the future showing will be much better than for the period mentioned.

The strain of the war was met as above described by an organization exerting itself to the utmost in direct participation in the war. Thirty-three per cent of the men connected with the home office were in the army and navy, including Lieutenant-Colonel H. M. Byllesby, Brigadier-General George H. Harries and Major W. R. Thompson, all serving abroad. At the properties the male forces were depleted from 14 to 50 per cent, while the executives and employees who remained behind were exceedingly active in civilian war work of all kinds. Byllesby & Company and affiliated companies and employees purchased a total of $2,558,150 of Liberty bonds.

The Byllesby plan of building up home ownership of their utility companies was continued successfully de-

spite many adverse conditions. For the year to Dec. 16 preferred stock sales at the properties aggregated $2,186,300 par value, there having been 4312 separate sales, or an average of five shares each. Bonds and notes absorbed locally aggregated about $2,750,000.

Byllesby & Company believe that the return to normal conditions in the operation of electric and gas companies will be steady and that enterprises which have withstood the exceedingly severe trials of the past two years are assured of a satisfactory future.

Lieutenant-Colonel Byllesby received his honorable discharge and rejoined the company of which he is president late in December, after a year's absence in the service.

NEW ENGINEERING HOUSE ESTABLISHED IN BOSTON

Engineering, Managing and Purchasing House of Merrill, Sweeney & Company Will Take Over Warner, Tucker & Company Properties

Meldon H. Merrill and Thomas B. Sweeney announce the organization of the firm of Merrill, Sweeney & Company, engineers, managers and purchasing agents, with offices at 50 State Street, Boston, where they are prepared to give special attention to the requirements of public utility properties and to engage in general engineering and construction practice. Both Mr. Merrill and Mr. Sweeney are well known in the New England electrical field.

Mr. Merrill is a native of Yarmouth, Me., and was educated at Tufts College, from which he was graduated in 1896 in the course in electrical engineering. He spent a year with the Boston Elevated Railway in the department of motive power and machinery, five years with the Edison Electric Illuminating Company of Boston, where he was active in commercial power work; eight years with the Westinghouse Electric & Manufacturing Company, specializing in mill power and textile motor applications, Boston office, and five years in the Boston office of the Allis-Chalmers Company, where he added paper-mill practice to his previous experience. He then became associated with the banking and managing house of Warner, Tucker & Company, Boston, where he had wide experience in financing, operating and purchasing for central stations, power companies, gas and street railway companies, including properties in the Connecticut Valley, Tennessee and Texas.

With the dissolution of Warner, Tucker & Company, resulting from the departure of R. L. Warner from Boston to become vice-president of the United Electric Railways of St. Louis, Mo., the public utility properties under the management of that firm will be taken over by Merrill, Sweeney & Company. These include the Texas Gas & Electric Company, serving eleven municipalities in Texas, and the Tennessee Eastern Electric Company, which includes the Johnson City Traction Company.

Mr. Sweeney is a native of St. John, N. B. His business career began in New England in 1901, when he joined the Boston office of the Westinghouse company as private secretary to R. L. Warner, then manager. In 1903 Mr. Sweeney became associated with Mr. Warner in the Federal Construction Company of Boston, which built a number of public service properties, including the Rockingham Power Company of Blewett Falls, N. C., now the Yadkin River Power Company, a 32,000-hp. initial hydroelectric development; the Greenville-Carolina Power Company of Greenville, S. C., a 6000-hp. development, and the South Carolina-Western Railway, a 300-mile steam road now a part of the Seaboard Air Line. Mr. Sweeney joined the organization of Warner, Tucker & Company in 1906 and became a member of that firm in 1914.

RECOMMENDATIONS MADE BY THE INCOMING NEW YORK GOVERNOR

New Executive Declares for Reconstruction Commission, Public Ownership of Utilities, Water-Power Conservation Policy and Changes in Commissions

In his inaugural address Governor Alfred E. Smith of N. Y., announced that he would appoint a reconstruction commission immediately.

"During this period of reconstruction," he said, "we must not forget that New York State is now the commercial center of the world, and that the great business interests of this state have made sacrifices because of war. Irresponsible and wanton attacks on business are a blow to capital and labor alike. The prosperity of the workingman depends in large part upon the prosperity of the employer. In framing laws and in administering government it is therefore of prime importance that legitimate business should be safeguarded, promoted and encouraged, to the end that we maintain our financial, commercial and industrial supremacy."

Governor Smith recommended that legislation be passed granting cities the power to acquire, own, operate and control their public utilities. In making this recommendation he said:

"Recent years have been marked by a great opening of the popular mind to the true scope of enlightened municipal administration. There is everywhere a recognition that it is only through the application of progressive conceptions of public duty that life can be made tolerable in our teeming cities, with their unprecedented growth in population and the consequent living conditions. From every city in the state, represented by the chief executives in conference, there comes the demand that the state confer upon the cities the power to acquire, own, operate and control their public utilities. . . . These great services are monopolies, and whatever is of necessity a monopoly should be a public monopoly, especially where it offers a service of universal use."

Declaring that the undeveloped water-power resources of New York surpass those of any other state in the Union and that the Niagara and St. Lawrence Rivers alone are capable of providing sufficient power for the ordinary needs of the state, Governor Smith said that development is impossible until the state adopts a definite policy upon this important question.

After the Governor has had time and opportunity to state what progress has been made in recent years by the Conservation Commissioner and what policy is under consideration by the conference of mayors of the state, who appointed a committee to draft a bill outlining a policy that meets with their approval, he will communicate with the Legislature. Single-headed public commissions are recommended.

PLANS OF MANUFACTURERS IN RECONSTRUCTION WORK

General War Service Committee of the Electrical Manufacturing Industry Calls Meeting of Chairmen to Be Followed by Conference

The General War Service Committee of the Electrical Manufacturing Industry, in Bulletin No. 13, addressed to every electrical manufacturer, states that it has carefully considered the type of organization best calculated to continue coöperation between individuals, companies and the industry as a whole with the government. It was recognized that to comply with the spirit of the times as shown at the Atlantic City war emergency and reconstruction conference any such organization must be founded on the constituent group idea.

As an instrumentality for initiating such a movement a meeting of all the present group chairmen is called for Jan. 7 in New York to confer upon and make recommendation as to further procedure. The success of this movement depends on the fullest opportunity being given for individual expression.

It follows in due course that representative group committees would be elected by each group and that a general executive committee, to succeed the General War Service Committee, would be selected to coördinate the various group committees in effecting the industry's contact with the government.

It is planned to call a mass meeting of the industry the latter part of January, in order to discuss and act on recommendations which may be formulated at the meeting of Jan. 7. At this meeting also it is expected that speakers of national prominence will discuss the various problems of reconstruction.

APPLIANCE SECTION OF THE ASSOCIATED MANUFACTURERS

At New York Meeting It Was Decided War Service Committee Should Be Maintained for Possible Future Contact with Government

A meeting of the Heating Appliance Section of the Associated Manufacturers of Electrical Supplies was held at the association's offices in New York on Dec. 17. It was the best attended and most constructive meeting yet held by this section.

The war service committee of the electric heating industry, of which W. M. Stearns is chairman, has been representing the manufacturers in their negotiations with the War Industries Board and other branches of the United States government. This committee reported on its work to date, and while the practical end of the war would act to terminate the functions of the committee it was felt by the manufacturers present that the committee should be maintained for possible future contact with the government on reconstruction or reorganization.

The feeling among the electric heating manufacturers is unanimous that advantage should be taken of the lessons in conservation learned under the pressure of war conditions. It is recognized that differences of opinion as to details will, of course, arise, but the present period of readjustment will be utilized to bring about methods of conservation and standardization.

The various sub-committees of the Heating Section of the Associated Manufacturers of Electrical Supplies were instructed to investigate and report on specific problems at the next meeting of the section, the latter part of January.

TO USE THE WEBB LAW TO FURTHER EXPORT TRADE

Companies Which Have Filed Statements with Federal Trade Commission Include Foreign Subsidiaries of General Electric Company

A number of companies have filed statements with the Federal Trade Commission indicating their intention to take advantage of the provisions of the Webb law permitting combinations in export trade. Among them are the Australian General Electric Company, the General Electric Company of Brazil, Inc., the General Electric Sudamericana, Inc., Cia. and the South African General Electric Company. These companies are subsidiaries of the General Electric Company, Schenectady.

CENSUS RETURN FOR THE CONNECTICUT STATIONS

Income from Electric Service Increased 100 per Cent in Five Years, While the Kilowatt-Hour Output Gained 164 per Cent

Preliminary figures from the forthcoming quinquennial report on the central electric light and power stations of the State of Connecticut have been given out by Director S. L. Rogers of the Bureau of the Census, Department of Commerce. They were prepared under the supervision of Eugene F. Hartley.

The statistics relate to the years ended Dec. 31, 1917, 1912 and 1907, and cover both commercial and municipal plants. They do not, however, cover electric plants operated by factories, hotels, etc., which consume the energy generated, those operated by the federal government and state institutions, nor plants that were idle.

The figures are shown in detail below:

	1917	1912	1907	Per Cent of Increase* 1907 to 1917	1912 to 1917
Number of establishments	43	44	41	4.9	—2.3
Commercial	37	38	36	2.8	—2.6
Municipal	6	6	5	20.0	.....
Income	$10,721,264	$5,347,552	$2,469,543	334.1	100.5
Electric service	$10,515,080	$5,057,132	$2,452,359	328.8	107.9
All other	$206,184	$290,420	$17,184	699.9	—29.0
Total expenses, including salaries and wages	$8,941,939	$4,109,311	$1,682,231	431.6	117.6
Number of persons employed	1,938	1,340	745	160.1	44.6
Salaries and wages	$1,872,148	$1,054,261	$529,652	253.5	77.6
Total horsepower	195,286	109,691	56,243	247.2	78.0
Steam engines:					
Number	110	118	123	—10.6	—6.8
Horsepower	162,042	89,372	37,492	332.2	81.3
Internal-combustion engines:					
Number	5	7	6	—16.7	—28.6
Horsepower	835	885	706	18.3	—5.6
Waterwheels:					
Number	44	51	54	—18.5	—13.7
Horsepower	32,409	19,434	18,045	79.6	66.8
Kilowatt capacity of dynamos	152,649	77,655	39,363	287.8	96.6
Output of stations, kilowatt-hours	345,563,143	130,672,201	67,406,232	412.7	164.5
Stationary motors served:					
Number	19,931	7,979	2,741	627.1	149.8
Horsepower	216,973	59,536	21,146	726.1	264.4
Number of street lamps:					
Arc	5,299	5,068	(2)	.....	4.6
Incandescent, etc.	26,467	21,620	(2)	.....	22.4

* A minus sign denotes decrease.

Associations and Societies

The Directory of Electrical Associations, which is regularly printed in the first issue of each month, appears on page 63 of this number.

Electrical League of Cleveland.—On Dec. 26 the Electrical League of Cleveland was addressed by Charles Higley on the subject "A Government of Laws and Not of Men."

American Electrochemical Society.—It has been announced that the spring meeting of the American Electrochemical Society will be held in New York City early in April, 1919. The exact date will soon be announced.

American Institute of Consulting Engineers.—On Jan. 13 a meeting of the American Institute of Consulting Engineers will be held at which the subject for discussion will be "The War and Reconstruction."

Pacific Service Employees' Association Elects New Officers.—The second annual meeting and election of this association was held in San Francisco on Dec. 10. F. R. George was elected chairman and R. W. Robinson secretary.

I. E. S., New York Section.—At a meeting of the New York Section of the Illuminating Engineering Society to be held on Jan. 9, in the Engineering Societies Building, a paper on "Urban Car Lighting" will be presented by Messrs. Wilder and Allen.

A. I. E. E., Washington Section.—Lieut.-Col. John H. Finney, a member of the Washington Section of the American Institute of Electrical Engineers, addressed the section's meeting on Dec. 10, speaking on "Experiences Abroad in the Study of Zeppelins." Lieut.-Col. Finney described his inspection of factories, flying fields and aircraft in England, France and Italy.

Society of Automotive Engineers.—The Society of Automotive Engineers announces that the date of its annual winter meeting has been changed from Jan. 12-14 to Feb. 4-6 as a matter of convenience for members who desire to attend the automobile show which will be held at Madison Square Garden the first two weeks in February. This meeting will be the occasion of interesting technical sessions.

A. I. E. E., Seattle Section.—"Electric Welding—a New Industry," a paper by H. A. Hornor which was printed in the October *Proceedings* of the American Institute of Electrical Engineers, was read before the Seattle Section of this organization at its Dec. 17 meeting by Mr. Lindsay. Mr. Bissell of the Puget Sound Navy Yard spoke on the latest results in electric welding at that yard, showing photographs of weld sections made there.

Engineers' Club of Philadelphia.—G. Douglas Wardrop will address the Engineers' Club of Philadelphia on Jan. 21 on the subject "War Aviation in Retrospect; Commercial Aviation in Prospect."

A. I. E. E., Chicago Section—Electric Club-Jovian League.—At a joint meeting of the Chicago Section of the American Institute of Electrical Engineers and the Electric Club-Jovian League held Dec. 30 Comfort A. Adams spoke on "Electric Welding in Shipbuilding."

Massachusetts State Association of Electrical Contractors and Dealers.—The annual meeting of the Massachusetts State Association of Electrical Contractors and Dealers will be held at the Hotel Bancroft, Worcester, on Jan. 9. It is planned to have the following speakers: William L. Goodwin, author of the "Goodwin plan"; Samuel A. Chase, special representative of the Westinghouse Electric & Manufacturing Company; E. R. Davenport, sales manager of the Narragansett Electric Lighting Company, Providence, R. I.; J. M. Wakeman, general manager Society for Electrical Development, and W. H. Morton, general manager National Association of Electrical Contractors and Dealers.

Joint Meeting of San Francisco Electrical Men.—A "get-together dinner" to which members of all branches of the electrical industry were invited was held in San Francisco on the evening of Friday, Dec. 13. Major George F. Sever, special representative of the War Industries Board, Power Section, acted as toastmaster. Branches of the industry represented by the speakers were as follows: National Electric Light Association, Arthur Halloran, secretary Pacific Coast Section; Electrical Development League, Garnett Young, president; California Association Electrical Contractors and Dealers, M. A. De Lew, president; California Electrical Co-operative Campaign, Lee H. Newbert, chairman; California Industrial Accident Commission, Robert Eltringham. Miner Chipman spoke on the subject of "Efficiency."

Boston Section, A. I. E. E., to Hear Mr. Luckiesh on "Camouflage."—"Camouflage on Land, Sea and Air" will be the subject of an illustrated address at Chipman Hall, Tremont Temple, Boston, on the evening of Jan. 7, by M. Luckiesh of the Nela Research Laboratory of the National Lamp Works of the General Electric Company. The meeting will be held under the auspices of the Boston Section of the American Institute of Electrical Engineers, and members of other engineering societies, ladies and all interested in camouflage are invited to attend. Mr. Luckiesh has been actively engaged in war work for the United States government involving the study and practice of camouflage in its most varied aspects. He was chairman of the committee on camouflage of the National Research Council.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Unremunerative Extensions. — The Pennsylvania Public Service Commission has handed down an order requiring the Chenango Valley Electric Company to furnish service to a resident of Farrell, Pa., who brought a complaint against the company for refusal to make the necessary extension for service. The commission says: "A public utility cannot choose and serve only the sections immediately remunerative. Whenever required to do so it should, at its own cost and expense, make all reasonable and needed extensions. The law does not contemplate that the patron should provide the capital to make such extensions. . . . In no circumstances should the burdens imposed by abnormal conditions be placed on the shoulders of the patrons."

Plant Held Inefficient, but Rate Increase Authorized.—In authorizing the Intermountain Railway, Light & Power Company to increase electric rates in Lamar the Colorado Public Utilities Commission says in part: "The Lamar plant of the Intermountain Railway, Light & Power Company is a very inefficient one, the coal consumption being in excess of 16 lb. of bituminous coal per kilowatt-hour of output. While it is fully realized that this condition cannot be corrected at this time on account of the difficulty in securing equipment, the company is not entitled to any reward for efficient operation in the disposition of this case. The cost of steam-power plant generation alone for the year 1917 was 70 per cent of the operating revenues for that period, and this ratio will probably be increased for the year 1918. There is also a very high unaccounted-for loss in distribution, which, in the opinion of the commission, does not result largely from leakage through trees, as stated in testimony. The serious problem before the commission, the company and the citizens of Lamar is that of providing sufficient revenue to enable the company to meet operating expenses necessarily incurred. It would be idle at this time to discuss the proposition of providing more efficient equipment for the purpose of reducing operating expenses. Such equipment, even if available, has so advanced in price that its substitution for the present equipment, even if obtainable, might not be desirable on account of the increase in fixed charges which would result. The commission is of the opinion that the rates of the applicant are unremunerative under the conditions prevailing at this time."

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Coal Price and Zone Regulations Continue.—Maximum prices on coal and zone regulations will not be removed before Feb. 1, 1919, United States Fuel Administrator Harry A. Garfield has announced.

Cleveland May Cut Street-Lighting Service.—Because of a shortage in finances in 1919, the committee on appropriations of the City Council of Cleveland, Ohio, has recommended a reduction of expenses in nearly all city departments. The budget for street lighting will probably be reduced $150,000 for the year. That will mean the discontinuance of about one-third of the number of gas lamps, about one-half of the "white way" lamps and about one-fourth of the arc lamps.

Declines Telephone Appointment.—Paul P. Haynes, a member of the Indiana Public Service Commission, has declined an appointment as a member of the national committee on standardization of telephone rates in the United States, the appointment coming from Director-General Burleson. Mr. Haynes said that not only were the requirements of the Indiana commission's post-war readjustment work too heavy to permit of his taking leave from that body but also that certain questions involved in the jurisdiction of the federal telephone control and the various state commissions caused him to decline the appointment.

Renewed Activity in Gas and Electric Industries.—William H. Clarke, manager of the bond department of H. M. Byllesby & Company, says: "We can again look forward to the renewed development of the electric and gas industries, because equipment and apparatus of all kinds should soon be more easily obtainable as national interests permit the release of manufacturing capacity from government work to ordinary pursuits. The importance of efficient and continuous gas and electric service has been emphasized by war-time necessities. Much of the ordinary and regular development or extension work of utilities during 1917 and 1918 has been postponed, and this accumulation will require immediate construction as fast as material and labor become available. The participation of local capital in the stock and bond issues of utilities has been growing rapidly. It may be expected that millions of people who have made their first purchases in public securities during the past two years will look to their local utilities as a safe and profitable medium for their investment funds."

To Study Government Ownership.—The Merchants' Association has appointed a committee of which Otto Kahn, James G. White and other well-known men are members to investigate government ownership and operation of public utilities. William Fellowes Morgan, president of the association, wrote as follows in asking the members of the committee to serve: "Although the Merchants' Association has hitherto contended that government ownership and operation are economically, politically and socially unwise and harmful, the changed conditions resulting from the war make desirable a reëxamination of the subject."

Examination for Aid Qualified in Radio.—The United States Civil Service Commission announces an open competitive examination for aid qualified in radio, for both men and women. Vacancies in the Bureau of Standards, Department of Commerce, for duty at Washington, D. C., or elsewhere, at $900 a year, and in positions requiring similar qualifications at this or higher or lower entrance salaries, will be filled from this examination unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer or promotion. The duties of this position will include miscellaneous laboratory work in the radio communication laboratories of the Bureau of Standards, with special assignment to sending and receiving in connection with experimental testing and developing work. Applications should be properly executed, excluding the medical certificate, and must be filed with the Civil Service Commission, Washington, D. C., not later than Jan. 28, 1919.

Radio Communication for President on the Seas.—President Wilson was in constant communication with the United States and France during his entire voyage from the United States to France through the U. S. S. Pennsylvania's powerful radio transmitting and receiving sets. The Annapolis high-power transmitting station, transmitting on 16,900 m., the high-power transmitting set at New Brunswick, N. J., transmitting on 13,000 m., the high-power transmitting set at Tuckerton, N. J., on 9200 m., and the high-power transmitting radio station in Lyons, France, on 15,500 m., were used for communications to and from the President. The President, on board the U. S. S. George Washington, was convoyed by the Pennsylvania, which is the best equipped ship afloat for signaling purposes in regard to radio communications, and five torpedo boat destroyers. The Pennsylvania transmitted messages direct to the United States up to a distance of 2500 miles. Communication with the Lyons station, France, was established long before the Pennsylvania was beyond communication range of the United States. The radio communication was directed by Commander H. W. McCormack, U. S. N., fleet radio officer. Lieut. S. V. Edwards is in charge of the radio of the Pennsylvania.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Uninsulated Wire.—Where a petition in action for death of lineman alleged in one place that "the insulation" on a wire "was rough and worn off," but in another place alleged that it was "uninsulated," it was not error to instruct that recovery could be had whether wire was wholly uninsulated or whether it had such defect in insulation as proximately to cause the injury complained of, according to the Supreme Court of Iowa in Shilling versus Sioux City Gas & Electric Company (169 N. W. 416).

Negligent Construction of Dam.—Although defendant had been given right to construct dam across Broad River by plaintiff's grantors as well as by law and plaintiff had purchased his lands subject to such right, defendant would be liable to plaintiff for damages to the lands due to negligent construction of dam. the Supreme Court of North Carolina held in Free versus Parr Shoals Power Company (97 S. E. 243). In action for damages to land due to negligent construction of dam which defendant had the right to construct it was unnecessary for plaintiff to allege that the injuries to his lands were different in kind from injuries to other lands similarly situated, since it is only where injuries arise from nuisance *per se* that peculiar damage must be alleged.

Remedy of Owner for Trespass by Municipal Plant.—Where a city constructed a power plant, and for operation thereof conducted water from a river and discharged it in large quantities into a slough, materially increasing the accustomed flow, to the damage of the owner of lower riparian land on the banks of the slough, such discharge constituted a continual trespass which riparian owner could have enjoined, the Supreme Court of Oregon held (175 P. 855). In the construction and operation of electric and waterworks for profit, the city occupies the same position as a private corporation organized to buy or sell and get gain, and in the same manner as an individual it is liable, both at law and in equity, for its trespass upon rights. Where a city diverted water from a river for operation of a water plant and discharged it into a slough in large quantities, materially increasing accustomed flow, so that the owner of lower riparian land on both banks of the slough could not ford the slough, as he had prior thereto been doing, and was compelled to go two miles out of his way to reach his plow land, he was entitled to damages.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Harold G. Payne, for the past year in charge of electrical designing construction at several of the government cantonments and formerly associated with M. J. Neall, consulting engineer of Boston, has recently opened offices as consulting electrical engineer at 201 Chamber of Commerce, Boston, Mass. Mr. Payne, after being graduated from the University of Minnesota, was for several years connected with Stone & Webster organizations at Minneapolis and elsewhere. For four years prior to becoming associated with Mr. Neall he was a member of the engineering staff of D. C. & Wm. B. Jackson. He has been engaged in electrical and allied branches of engineering in Boston and Chicago.

Capt. William T. Taylor, who has been in active service since 1915, for the past six months has been a staff officer with the British Air Forces and

CAPT. W. T. TAYLOR

is on the Air Ministry staff. Since 1916 he has taken an active part in the welfare of disabled soldiers and their training for industrial employment after the war. Captain Taylor is a member of the American Society of Mechanical Engineers, a member of the British Institution of Mechanical Engineers, a fellow of the American Institute of Electrical Engineers, a member of the British Institution of Electrical Engineers, and is the author of "Transformer Practice" and of "American Hydroelectric Practice."

L. S. Brainerd has been appointed safety engineer in charge of the inspection division of the Utilities Indemnity and Fire Exchanges. For many years Mr. Brainerd was engaged in experimental work and in construction and operation of various important electric, gas and waterworks plants. For the past fifteen years his activities have been in the line of safety engineering and inspection work. He has resigned the position of supervising inspector for the St. Louis district, in charge of all character of inspections, for the Travelers' Insurance Company and Travelers' Indemnity Company of Hartford, Conn. Mr. Brainerd holds certificates of competency as inspector for the states of New York, Pennsylvania, Ohio and Wisconsin.

Hamilton F. Gronen, commissioner of the municipal light and water department of the city of Tacoma, Wash., has resigned his position, following a disagreement with the City Council in regard to power development of the municipal properties. It is understood that Mr. Gronen is about to resume the practice of his profession of engineer.

W. C. Campbell has been promoted from assistant to general superintendent of the Columbus (Ohio) Railway, Power & Light Company, succeeding H. W. Clapp, who was promoted to be general manager. Mr. Campbell graduated from Union College in Schenectady in 1900. He spent one year in the General Electric shops, another in special work at Purdue University and a third on the General Electric test floor, when he was assigned to the New York territory of the company. In 1907 he resigned to become general carhouse foreman for the New York Railways, but in the following year he returned to the General Electric Company in the New York territory and shortly afterward was transferred to the San Francisco and Portland district. In 1914 he became associated with the Columbus property as assistant general superintendent.

C. M. Kaltwasser has resigned as vice-president and general manager of the Harrisburg (Pa.) Light & Power Company, and after Jan. 1 he will be connected with the Century-Plainfield Tire Company of Plainfield, N. J., as president and general manager. Mr. Kaltwasser was born in New York City in 1883 and was graduated from the Stevens Institute of Technology in mechanical engineering. He was first connected with the Connecticut Railway & Light Company as a cadet engineer and later for three years was in charge of the South Norwalk division of the company. In 1910 he became commercial representative in the New York office for the Susquehanna Railway, Light & Power Company, later the United Gas & Electric Company, and after some traveling about among the properties was appointed manager of the Lockport (N. Y.) Light, Heat & Power Company. In the fall of 1914 he became general manager of the Harrisburg property, in which work he has continued up to the present time.

James T. Hutchins, formerly vice-president and general manager of the Rochester (N. Y.) Railway & Light Company, has been elected president of the company, succeeding the late Horace E. Andrews. Mr. Hutchins has been general manager of the company since early in 1909. He was graduated in 1889 from the Massachusetts Agricultural College in Amherst and shortly afterward became connected with the Thomson-Houston Company. Later he was appointed assistant superintendent of the West End Electric Company of Philadelphia. He was promoted to be superintendent, retaining that post until the Philadelphia Electric Company was organized in 1897, when he became its electrical engineer. In 1904 he joined the Rochester company as superintendent of the electrical department, two years later was promoted to be assistant general manager

J. T. HUTCHINS

and three years after that to be general manager. In 1917 he was elected vice-president in addition. Mr. Hutchins was a member of the State Advisory Board in the United States Employment Service Organization, assisting the government in labor distribution.

Obituary

Harry L. Bleeker, vice-president and general manager of the Washington Water Power Company, Spokane, Wash., died recently of pneumonia at the age of forty-five years. Mr. Bleeker was born in Belleville, Ontario, and had been with the Washington Water Power Company for the past sixteen years. After studying law he entered the legal department of the San Diego Street Railway and in 1900 became private secretary to J. P. Graves at Grand Forks, B. C. Two years later he went to Spokane and became private secretary to the late Henry M. Richards, then president of the Washington Water Power Company, and to D. L. Huntington, now president of the company. In 1903 he was made secretary and later was chosen vice-president.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

TRADE MEETS MANY PROBLEMS IN YEAR JUST CLOSED

Review of Sales, Production and Distribution Activities of Manufacturers and Jobbers During 1918

Many startling changes have taken place in the electrical commerce of the nation during the past year. The industry has gone through a period of maximum production, government control, priorities, etc., and is now once more in a free market.

Up to the date of the signing of the armistice the industry was almost entirely engaged in producing goods for government or allied consumption; the trade a large part of the time was serving only essential demand. Commercial business was reduced to the barest minimum. There was some commercial business, but it is doubtful if on the whole it represented more than 25 or 30 per cent of the entire output of the industry for the first ten months of the year. Even those lines which at first blush might be considered non-essential — such, for instance, as the appliances—had a big war demand.

Heaters for aircraft guns and for ship bridges, electric ranges for the army and navy, fans for the government offices and for the navy, dry batteries for radio sets on airplanes, and a good many more too numerous to mention, were sold to the government in large numbers.

Up to Nov. 11 shops were generally working to the extent that they could get labor to operate the machinery. Since that time there have been many cancellations of war and other contracts, and incoming business is now small. The total output for the year was probably no larger than in 1917, which was in the neighborhood of $750,000,000. Throughout the year labor first and raw materials second have been the controlling factors. In addition to a very acute shortage of each, labor has been very undependable. Dilution was tried and found in most instances to work very well. Women as a rule were found to be more dependable in the work in which they were employed than men. Wages for industrial labor advanced by leaps and bounds. The government labor board did much to prevent loss of time through strikes, but it pretty generally recommended higher wages and the shortening of working time to eight hours. This latter did not actually shorten the hours of work but materially increased wages by making it possible to get in more overtime work. Labor priorities were outlined, and in one instance in the industry labor was close to being drafted.

Raw materials, particularly iron, steel, copper, tin and brass, were insufficient to supply the demand. Substitutes were urged, particularly for brass. Prices of these products were fixed by the government with provisions for maximum output, but even so there were not enough to go around. The natural result was that along in the summer the War Industries Board began to limit the supply of raw materials through priority certificates in accordance with the essential character of the production. Nothing was termed non-essential, but many lines of production were considered less essential to the winning of the war than others.

There consequently sprang up a system of classification. Those industries in Class A or AA were reasonably sure to be able to get all of the raw materials needed; those in Class B (electrical manufacturers automatically were in this class) would for the most part probably be taken care of, while those in Class C (less essential, with curtailed production) would be apportioned raw material sufficient to take care of the curtailed output, provided that the material was available. In all cases, however, individual orders might receive a higher classification than the automatic rating, and it did so happen frequently.

Many electrical lines had to curtail their production considerably as a result. As the fighting stopped curtailment in many other lines was under consideration at Washington or by the manufacturers for recommendation to the War Industries Board.

Thus the output of fans was curtailed to 40 per cent less than the 1917 production, vacuum cleaners for six months from Oct. 1 were curtailed to 75 per cent of six months of 1917 production, heating appliances production to 50 per cent of 1917 output, etc.

The curtailment was largely taken care of by reducing drastically the number of sizes and types of product. In some instances whole lines were abandoned. Such lines were clearly not necessary to winning the war. They were for the most part in the luxury class. Much of the curtailment also was taken care of by eliminating, at least for the period of the war, the "special" article. In the wiring device line particularly there were a number of special types.

Naturally such a condition tended to hasten standardization in the electrical line. Much that happened under stress during the year gone by has been talked over repeatedly in former years at committee meetings. Now that the restrictions are removed, some of these lines will probably again come on the market but not all. In the wire field, for instance, Nos. 8, 10, 12 and 14 double-braid seem likely to be discontinued. Heating-device manufacturers are to meet this month to discuss standardization, among other things, of output. The jobbers have asked for more standard lines as they reduce the amount of stock that must be carried and therefore decrease the cost of doing business. Standards of dome reflectors were adopted by the manufacturers.

War conditions caused many parts of the industry to organize. Some of these formed sections of the Associated Manufacturers of Electrical Supplies, and others, such as the manufacturers of portable electrical tools, hoists and stokers, formed independent associations.

Incandescent Lamp Advance

For the first time the price of incandescent lamps advanced. The first advance was on Jan. 1, 1918, and called for 10 per cent. Ten months later vacuum-type tungsten lamps advanced again, this time 15 per cent. Miniatures, carbons and gems advanced 10 per cent during July.

The shortage of lamps that arose during the latter part of 1917 was well caught up with by February. Manufacturers begun to rearrange agents' stocks and as a result greatly increased the movement of all sizes. Production was pushed and agents were urged to stock up in the summer months. Lamp sales for 1918, it was reported, were running ahead of 1917. September sales were roughly 30 per cent greater than for September, 1917.

In September it was recommended by the Fuel Administration to stop the output of gem lamps and to use carbons only for rugged service. Other changes were recommended, all to make the most efficient use of fuel. These restrictions are now off, but it is doubtful if anything like the normal production will ever again take place in the curtailed types. Already a rugged-type tungsten lamp is on the market to compete with the carbon lamp.

Wire

Copper wire, the output of which has a greater value than any other electrical product, was higher at the close of the year than at the beginning, but the average throughout the year was below that for 1917. The increase during the year was due to higher copper, higher cotton and higher labor. During December wire base dropped a couple of cents. The highest for rubber-covered wire base was, considering all discounts, 34 cents.

The wire industry up to September roughly was working 80 per cent on government orders. At that time the Signal Corps increased its order from 10,000 to 65,000 miles monthly of outpost wire. This was more than the industry could immediately handle, but additional machinery was purchased and work begun. From that time on it was almost impossible to get small sizes of braided, stranded wire. Heater cord was virtually out of the market. So far as can be learned the manufacturers are still working on this order. Stocks of wire held in anticipation of government orders are now beginning to appear.

Appliances in Large Demand

Throughout the year sales of electrical appliances were very large. Stocks were short and manufacturers were behind on orders. Washing-machine manufacturers, even though they early in the year decided to eliminate 171 distinct styles, by the first of June in many plants were 2000 to 3000 machines behind the orders.

It seemed almost impossible to get a stock of licensed flatirons after the middle of the year. Even electric ranges sold better in 1918 than in 1917, reports up to August indicate. Sales were mostly in small quantities and in small cities, the big cities having ceased to push ranges during the war.

Fans were sold out early to the trade. The consumer demand was greater than the supply in 12-in. and 16-in. oscillators, but not so good in the small sizes. Government demand was large.

Prices on all appliances advanced considerably and as a rule more than once during the year.

Central stations during the year received recognition in the way of a discount differential in the distribution of electric ranges, while the jobber received similar recognition in the distribution of socket heating devices.

Early in the year some of the large central stations cooperated to purchase 30,000 portable lamps to sell at a low figure. These sold so well that the scheme has been greatly enlarged.

Large power equipment was hard to get throughout the year. In November six months were quoted on motors of more than 100 hp. Turbines of over 500 hp. were taken under complete government control as to distribution. After the fighting stopped deliveries on large turbines were quoted at four months and longer, depending on the condition of the individual factories. At the close of the year there was still a large volume of unfilled business in steam turbines.

In the spring stocks of small power equipment began to appear, and conditions in this line have been getting better and better. The used-equipment dealers, while finding it difficult to take care of inquiries for large equipment, report that the market for small machines is dull.

The transformer demand was not so large last year as in the preceding year. In April it was reported to be down to about 70 per cent of that for 1917.

Around the first of June power equipment, including motors, generators, turbines, transformers, etc., advanced about 10 per cent.

Prices on small material advanced as a rule 25 per cent or more during the year. Some items, such as lamps and flashlamps, were increased in price for the first time. Metals and labor generally caused the advances, but not a few were caused by the sky-rocketing of cotton. Tapes and insulated wire especially reflected the cost of cotton in higher prices. The 25 per cent advance in freight rates was the occasion also for a number of advances, particularly items of large bulk, such as conduit, poles, cross-arms, etc.

Building, except for war purposes, was very small all year. Yet even such as was projected was held up by the government late in the year. This was expected to show a heavy slackening in orders to jobbers. By the time, however, that the building curtailment order was fully in effect the jobbers were operating under a pledge not to supply materials except for essential purposes. This pledge was kept remarkably well by the jobbers.

The jobbers were very much pleased at being recognized by the government. They were given a B rating in the preference list and later were allowed an A rating for replacement of iron and steel stocks that had been diminished by orders with an A or AA rating.

The jobbers were relieved of their pledge Nov. 18, about the same time the restrictions on new buildings were withdrawn.

Jobbers' stocks were as large during the year as they could maintain them, but after fighting ceased ordering was shortened. It was stated at the Cleveland convention of the jobbers that jobbers have a stock of $40,000,000 and are doing a business annually of $300,000,000.

As the year closed local jobbers' stocks were in pretty good condition, small wire being perhaps in poorest supply. Conduit, which had been particularly short all through the year, was beginning to come in fairly well, as was heater cord.

The cost of doing a jobbing business continued to increase during 1918. Labor was a particularly costly item. More capital to the extent of 25 to 30 per cent was needed to do business.

Considerable difficulty was experienced in handling government orders. The government's way of doing business is different from that of regular commerce, and where so much was ordered by the government the trade particularly was greatly handicapped. The slowness with which payments were made was perhaps the most trying.

On the other hand, the government orders, it was noticed, brought a lessening of the small-order business. In certain sections of the country the jobbers made considerable progress in retiring from the retail sales end of the business.

The shrinkage and then curtailment of new building caused watt-hour-meter sales to fall off a great deal. Housing projects and exports, however, served to bring in a tidy volume of business.

A number of manufacturers began to study the export field during the year. There were quantities of inquiries from South America, but the ban on shipping made it hard to do business. However, as soon as the war ceased the manufacturers began to show unusual activity.

American manufacturers during the past year have developed quite a few electrical fittings and, it is understood, some wire for use in foreign markets. With the establishment of branches of American banks abroad American manufacturers are apparently going after foreign trade strong.

Electrical exports during the fiscal year ended June 30, 1918, were the largest for any fiscal year, amounting to

NEW YORK METAL MARKET PRICES

	Jan. 7, 1918	Dec. 23, 1918
Copper	£ s d	£ s d
London, standard spot	110 0 0	122 0 0
	Cents per Pound	Cents per Pound
Prime Lake	Govt. price 23.50	Govt. price 26.00
Electrolytic	Govt. price 23.50	Govt. price 26.00
Casting	Govt. price 23.50	Govt. price 26.00
Wire base	27.00	28.75
Lead, trust price	6.55	6.50
Nickel, ingot	50.00	40.00
Sheet zinc, f.o.b. smelter	19.00	15.00
Spelter, spot	7.82½ to 7.91¼	8.47½
Tin	85.00	71.75
Aluminum, 98 to 99 per cent	34.00 to 36	Govt. price 33.10

SOLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	22.00 to 22.50	17.00 to 18.00
Brass, heavy	14.00 to 14.50	10.00 to 10.50
Brass, light	10.00 to 10.50	8.00 to 8.50
Lead, heavy	6.00 to 6.12½	5.25 to 5.50
Zinc, old scrap	5.00 to 5.50	5.25 to 5.50

$54,527,570, in comparison with $51,903,823 for the previous year. Exports for the first eight months of 1918 amounted to $38,610,824, or at the rate of $55,000,000 for the year. Figures for the calendar year 1917 were $55,478,079.

Metal prices, generally speaking, were much lower at the close of the year than at the opening. Copper, which owing to the continuance of the government price of 26 cents until Jan. 1 is apparently higher, was actually being offered for resale during the last two weeks of the year at 21 cents. Producers late in December agreed on a price of 23 cents for export. Prices at the beginning and end of the year are given in the tables printed on the preceding page.

Even with the tremendous totals for Liberty bonds and the large income and other taxes, collections were well maintained during the year. Credits, of course, were very closely watched. The Engineer Depot, which purchased large quantities of electrical supplies, made strenuous efforts to take advantage of cash discount.

Both manufacturers and jobbers urged the use of trade acceptances, and the latter particularly made good use of them, especially with slow-pay customers.

The electrical industry enters the new year looking for business. All priorities and restrictions are off—the bars are down. For the first time since the late summer of 1915 has a buyers' market in any degree been present. Prices, however, are up, and there are no indications that they will come rushing down. That there will be a drop none deny, but a slowly drawn-out affair is expected.

Both the producing and the wholesaling branches seem to be in good shape to stand a few lean months, after which a steadily growing demand is anticipated. The industry closes the three best years in its history.

SURPLUS WAR STOCKS NOT TO BE USED TO BREAK MARKETS

Manufacturers Are Assured Utmost Protection—Government Departments' Foreign Purchasing Commissions Supplied First

Government surplus stocks piled up in 1500 warehouses of the War Department are to be disposed of in such a manner as to affect the market prices least. No small groups of men are to be allowed to buy at ridiculously low prices and then glut markets at fair prices, thereby making enormous profits such as were made at the end of the Civil War. Preferential markets are to be supplied first. Those include the Post Office, Agricultural and other federal departments, the Red Cross, Y. M. C. A. and purchasing commissions for foreign governments. This is the plan outlined to business men and manufacturers on Dec. 22 at a meeting of the Chicago Association of Commerce by L. H. Hartman, director of the Surplus Stock Division, established in the Munitions Building, Washington. The machinery for the disposal of surplus stocks has been decentralized as much as possible, the country being divided into thirteen zones.

No one knows how much stock there is on hand for disposal and no one will until the inventory of Jan. 1 has been taken and deductions have been made for an army of 2,000,000 men up to July, 1919, and of 500,000 men to July, 1921.

The first thought of the division, said Mr. Hartman, was to protect the manufacturer from unfair competition induced by auctioning of immense stocks to small groups which would learn of the government's routine. Thus elimination of the middleman's profits is to be accomplished.

When these "preferential markets" are supplied, and at a favorable time determined upon by full consultation with representatives of the manufacturers interested, auctions will take place, but only after the widest publicity has been given and the original manufacturer has had every opportunity to buy back his own product at the price at which it was furnished.

Instances of the preferential disposal of stocks were given as follows: The 180,000-tonnage per month allotment for Belgian relief will come from the surplus stocks. Through the War Trade Board, the Russian Purchasing Commission has arranged to ship to Siberia 800,000 pairs of shoes and immense stocks of clothing. Aeroplanes, automobiles and trucks to the extent of $45,000,000 will go to the Post Office Department. The Department of Agriculture will take 10,000 cross-cut saws, 30 miles of telephone wires, 1000 units of office furniture, 1000 wagons, 15,000 stoves, 1000 fabricated houses and 10,000 miles of barbed wire.

When it was learned that 90,000 tons of sulphur had been accumulated two of the largest producers were called to Washington and agreed with the division that, in order not to disturb the market price of sulphur, they would dispose of 1000 tons of the government supply at the same time and price as each 1000 tons of their own output.

Inasmuch as the Allies also have enormous stocks on hand, General Pershing has arranged for an interchange bureau. Locomotives, heavy construction equipment and trucks are not to be returned to this country but will be disposed of along the same stabilizing lines in foreign countries.

ELECTRICAL EXPORTS FOR MONTH OF AUGUST LAST

Figures for First Eight Months of Year Indicate a Total of Around $55,000,000 for the Twelve Months of 1918

Reports on electrical exports for August last have just come in and show a total for the month of $5,340,110, in comparison with $3,607,278 in August, 1917. The difference is explained largely by the figures for transformers, which were $554,576 in August last and but $95,311 in August, 1917. Higher prices were undoubtedly accountable for a large portion of the remainder. The exports of insulated wire and cable amounted to $676,670 in August last.

Exports of electrical merchandise during the first eight months of 1918 amounted to $38,610,824, as compared with $36,035,423 for the similar period of 1917 and $23,536,406 for the first eight months of 1916. Roughly, 10,000,000 tungsten lamps were exported during this period of 1918. For the most part the 1917 and 1918 figures run about the same, the most notable increases being in transformers. Insulated wire and cable appears to be running behind. This, however, can be explained by the lower prices that prevailed for wire in 1918. Copper prices reached a level more than 50 per cent higher than the 1918 average.

Based on the figures for the first eight months of the year 1918, exports are running at the rate of $55,000,000.

The accompanying figures were compiled from reports by the Bureau of Foreign and Domestic Commerce.

	August		Ten Months Ended August	
	1917	1918	1917	1918
Batteries	$242,668	$252,529	$2,380,384	$2,068,187
Carbons	137,055	123,926	*239,883	1,009,435
Dynamos or generators	295,029	258,589	1,751,221	2,195,653
Fans	42,394	29,296	421,430	681,267
Heating and cooking apparatus	22,174	79,954	*45,469	422,232
Insulated wire and cables	389,909	676,670	4,717,957	3,665,799
Interior wiring supplies, including fixtures	111,961	108,386	865,087	1,003,240
Arc lamps	486	2,135	12,222	9,323
Carbon-filament lamps	14,886	5,474	127,416	62,091
Metal-filament lamps	181,571	203,046	1,811,096	2,241,894
Magnetos, spark plugs, etc.	202,680	181,347	*472,621	1,742,645
Meters and measuring instruments	73,955	189,393	700,275	1,362,019
Motors	436,232	573,547	4,130,170	4,899,746
Rheostats and controllers	18,762	17,408	*32,963	154,585
Switches and accessories	158,546	159,811	*335,598	1,549,917
Telegraph apparatus, including wireless	47,735	36,858	452,644	196,971
Telephones	118,551	259,185	1,388,487	1,999,846
Transformers	95,311	554,576	949,990	2,180,776
All other	1,017,373	1,627,980	15,200,510	11,165,198
Total	$3,607,278	$5,340,110	$26,035,423	$38,610,824

* Figures cover period beginning July 1.

INCREASED SALES OF PLEASURE ELECTRICS

The Prevalent Gasoline Shortage and Existing High Prices Have Served to Make the Electric Car More Popular than Ever

During the past year the demand for electric passenger cars has reached proportions never before attained in the industry. Shortage of gasoline and consequent high prices, combined with government restrictions, have greatly increased the sales of electric cars. In foreign cities, particularly London, this type of car is extremely popular, and shipments of American cars will now go forward rapidly on large back orders. In Norway and Sweden great electric vehicle developments have taken place, and large installations of cars of American make have been made and are operating satisfactorily. Gasoline in Norway and Sweden during the war period reached $1 a gallon, making the operation of a gas car almost prohibitive. Good performance of electric passenger vehicles in the United States last winter, when conditions were particularly trying, coupled with the scarcity of good chauffeurs, insures a healthy and growing domestic market for the electric passenger car. Deliveries are improving and shipping facilities will be plentiful soon, the manufacturers state.

METAL MARKET SITUATION

Copper Quotations Lower—Brass Manufacturers May Unite for Export Trade

This is the last week of government prices. From now on metals will be in a free market. As indicative of what may be expected is the announced export price of 23 cents for copper. However, resale prices are even lower—21½ cents for January shipments, 21 cents for first quarter and 20 cents for first half have resulted in business.

Tin, while it is being held by the government at 72½ cents, is being quoted outside at under 70 cents. Lead is also coming down. The trust price is unchanged at 6 cents, but offerings were made last week at 5½ cents.

Scrap metals showed a loss all along the line during the week.

Brass manufacturers and other domestic companies which make copper rods, wire, etc., are discussing some sort of a combination to handle the export sales of their products.

In all probability a corporation will be formed along the lines of the Copper Export Association, Inc., which was organized on Dec. 17 to offset the buying of metal by various foreign combinations, and is expected to include American Brass, Bridgeport Brass, National Conduit & Cable, and other companies. Anaconda Copper Mining Company might also take part in the movement, since it is a big producer of copper rods and wire.

NEW YORK METAL MARKET PRICES

	Dec. 23	Dec. 30
Copper:	£ s d	£ s d
London, standard spot	122 0 0	112 0 0
	Cents per Pound	Cents per Pound
Prime Lake	Govt. price 26.00	23.00
Electrolytic	Govt. price 26.00	23.00
Casting	Govt. price 26.00	23.00
Wire base	28.75	28.75
Lead, trust price	6.50	6.00
Antimony	7.62½	7.62½
Nickel, ingot	40.00	40.00
Sheet zinc, f.o.b. smelter	15.00	13.00
Spelter, spot	8.47½	8.15
Tin	71.75	Govt. price 72.50
Aluminum, 98 to 99 per cent	Govt. price 33.10	Govt. price 33.10

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	17.00 to 18.00	16.00 to 16.50
Brass, heavy	10.00 to 10.50	9.00 to 9.50
Brass, light	8.00 to 8.50	8.00 to 8.25
Lead, heavy	5.25 to 5.50	4.50 to 4.75
Zinc, old **scrap**	5.25 to 5.50	4.75 to 5.00

THE WEEK IN TRADE

AS IS usual, business in the pre-inventory days is quiet. However, the trade and manufacturers see considerable brightness after the first of the year.

Prices up to the first of the year have been remarkably firm. There seems to be speculation at this writing concerning what may happen after the inventory period.

Building is still quiet, although architects are known to be giving estimates on many projects. The government officials continue to urge appropriation for public works.

NEW YORK

Everything is quiet. After January first inventories better business is expected. There is a feeling that some price revisions may follow inventory taking. Jobbers are ordering virtually nothing and are trying to keep stocks as low as possible, at least until after inventory taking. Manufacturers, however, seem filled with a similar desire to reduce stocks and as a consequence are rushing goods on back orders to dealers as fast as they can. Prices are holding up, but without bidding this indicates nothing.

WIRE.—Plentiful jobbers' stocks of all sizes have come to light. There is no bidding, however. Manufacturers, it is reported, have heavy stocks of copper and orders placed with refiners with a "no cancellation" clause. On this basis it would not be unreasonable to suppose that dealers would be held to the orders for future delivery.

CONDUIT.—No indications of a price change are apparent locally. Plenty of pipe is coming through. Jobbers, however, will probably maintain smaller stocks now than they have done. Deliveries are so much better and more certain that shipments will again be made to customers from manufacturers' stocks. This is in line with the intention of jobbers to watch stocks more carefully and curtail on expenses.

ARMORED-STEEL FLEXIBLE CONDUCTOR.—There is no demand locally, and stocks are naturally large. The housing projects did not develop so large a demand for this material as was anticipated. Knob-and-tube work was more generally used.

SCHEDULE MATERIAL.—Business is quiet. Stocks are coming in and are considered ample. They might have been considered small, however, four months ago. Manufacturers are cleaning up on back orders.

CHICAGO

All down the line the Christmas business in electrical circles was a smashing success. Jobbers, dealers and central-station merchandising men all agree that 1918 was the biggest year they individually ever had, and that December was a banner month among banner months. Every night for the last two weeks the men of the Edison Electric Shop sales force have worked until midnight or later restocking the depleted floor and shelves which were each day eagerly beset by throngs of shoppers. The electric shop's business for the year showed an increase of 40 per cent gross. Silk shades and lamps were the most active items, showing an increase of 50 per cent over last year's record. Appliances showed an increase of 25 per cent.

The real retail problem now is to get together enough goods to use in the January clearance sales. So depleted are the stocks that large orders for merchandise to use in clearance sales were going out on Dec. 28. Stock taking will be a very simple job.

Jobbers' stocks are well in hand. The only item they

are seriously long on is wire. Because they had to order it well in advance and did not buy subject to cancellation great quantities of it were shipped almost immediately upon the signing of the armistice.

The opinion is gradually gaining among manufacturers that the next business will come from the public utilities. The success which attended the efforts of the West Penn Power Company and the Consumers' Power Company of Michigan in raising several million dollars of 6 per cent money is taken to indicate that public utility financing is already easily possible.

The price question is disturbing markets somewhat, but it is difficult as yet to get any definite trends out of the changes that have taken place. That copper and steel will both be cheaper in 1919 than they were in 1918 seems to be established as a fact.

Labor is becoming plentiful at what appears to some to be an alarming rate. A permanent office through which discharged army and navy men will be found jobs will soon be opened. There appears to be a shortage of clerical jobs at present.

Members of the Chicago district board appointed to adjust cancellations of war contracts are fully prepared to expedite matters. The government's policy on sales of supplies and equipment now in warehouses is regarded as extremely fair. There will be no dumping of goods in a manner to break markets, it is reported.

Optimism of the first water prevails regarding the outlook for business in 1919.

COPPER WIRE.—Chicago jobbers are long on wire. One jobber is holding his base price of rubber-covered wire at 34 cents, but the market is at 32 cents. Weatherproof wire is on a 32-cent base.

APPLIANCES.—Shipments that should have come in before Christmas are arriving now. The Commonwealth Edison Company claims it could have sold $25,000 more goods if it had received them in time. There was some heating-device shortage among the jobbers before the holidays.

CONDUIT.—It is said that merchant pipe will be off about 5 per cent in price on Jan. 1. Rumors of lower prices in conduit predict declines of from 3 to 6 points indicating a reduction of from 4 per cent to 8 per cent.

BOSTON

Trade reflects the usual dullness at the final turn of the calendar, but the opinion is general that the industry is only taking up a notch in its belt in preparation for a fine run of business this year. Collections are fairly good and stocks on the whole well prepared to meet expected demands. Labor conditions are reasonably good, barring the continued strike at the Pittsfield works of the General Electric Company. There are signs that many more workers will return to the shops this week, and so far the employees of the company at the Lynn factories have remained "on the job." Central-station power business is showing a moderate falling off as the November figures are analyzed and as present loads are considered, but this is being to a considerable degree offset by increased use of lighting service. Men from the national service are being generally absorbed into the trade and industry. Contractors are getting busier with estimates than for some time. Fan-motor prices are up 15 per cent for this year's models, but other prices are holding pretty steadily to the levels of the last few weeks. There is less disposition to wait for sharp cuts in prices before placing orders, although houses heavily stocked are naturally slow to go into the market until their accumulated material begins to run much lower.

AUTOMOBILE SUPPLIES.—Electrical supplies for automobiles are moving unusually fast. Stocks are being well maintained and deliveries are more satisfactory than for some time. Distributers are "cashing in" upon the open winter. Batteries, lamps, starting sets and lighting units are in good demand for cars kept in operation as well as for annual overhaul work in the garages.

MOTORS.—The demand holds up well despite the temporary reduction in power requirement due to cancellation of war contracts. Business appears to be undergoing a steady transformation to a peace basis, and an indication of the healthy state of the electrical market is afforded by a recent auction sale of motors at a war plant in Connecticut. Twenty-six motors ranging from 3 hp. to 50 hp. in rating and aggregating 305½ hp. were knocked down at practically list price, so keen was the competition among bidders for these three-phase, 550-volt machines. So far the primary market has shown little tendency toward disorganization as a result of the release of war-plant equipments. Stocks are in good shape up to 50 hp.

FANS.—An advance of 15 per cent in 1919 designs of fans is announced. As many jobbers ran low on last year's purchases and are not carrying over substantial stocks, orders at the new prices will be in style before long. It is believed that the public will be in the market for a large supply of fans this year, apart from the possibilities of the weather.

ELECTRIC RANGES.—Sales in 1918 were held back by the conservatism of central stations regarding extensions, but the outlook for the new year is excellent. Carload shipments are coming into New England, and one central station has just purchased twelve ranges for stock in anticipation of 1919 delivery requirements. During the war it is safe to say that for every five electric ranges placed in service in New England thirty-five orders for range services had to be declined by the central stations, but this condition is sure to relax this year in face of the demand for ranges on the part of the buying public. Already there are hints of one or two central stations breaking away from the conservative policies as to extensions which characterized 1917 and 1918. Distributers are laying in good stocks of ranges for immediate delivery, and where high-class service is a sequel to installation a substantial growth of business is to be expected. The institutional market looks particularly bright at this time. Prices hold firm. It is believed that this will be an excellent range year in the prosperous residential cities and towns of eastern Massachusetts in particular and in many sections of New England where low-cost energy is available from large steam-turbine or water-power plants.

FIRE-ALARM TELEGRAPH APPARATUS.—Inquiries are increasing, and the prospects of enlarged sales to municipalities are good. Prices have not advanced as fast as in many other lines, and this is expected to stimulate trade in the new year. The factories are now in excellent condition to produce this class of equipment.

WIRE.—Prices do not show much change as yet. The demand reflects the slowness of building operations to get under way. Meanwhile stocks are accumulating somewhat, and the outlook is good for the year's business.

WASHING MACHINES.—The market is still oversold. One prominent jobber remarked Monday that he always seems to be a couple of carloads behind and begins to wonder if the supply will ever equal the demand.

APPLIANCES.—The Christmas trade ran about neck and neck with last year's. The lighter devices were in heavy demand where they were put in the public's way, but in cases where they were exhibited below stairs or on side streets trade was less satisfactory. Deliveries are now so good that distributers and retailers will be able to "make a killing" in 1919 if they cultivate the market intensively.

ATLANTA

Representatives of various building exchanges in the Southeast appear to be very optimistic regarding the building situation for 1919. Some predict that this year's construction will be a record breaker. The consensus of opinion among architects, engineers and contractors is that material prices are not going to decline for some time to come, and that since restrictions are off there is no reason why activity in building should not begin immediately. New plans covering substantial construc-

tion are being distributed, and it looks now as though the Southeast will again be busy on normal commercial construction. A great deal of activity is noted in the real-estate field, and this is in a measure a barometer of building activity. Compared with the previous week, there is practically little wholesale activity in the electrical field, but this is to be expected during the holidays and inventory period.

The government will expend approximately $500,000 for additional hospital accommodations at Fort McPherson, Atlanta, Ga. This will call for more electrical material. The Birmingham Steel Corporation is planning the erection of additional buildings. Contemplated ultimate expenditure will be from $15,000,000 to $20,000,000.

The lumber industry of the South is entering upon the greatest development in its history. Information at hand indicates that the export demand this year will be greater than ever. Sawmills have been working short-handed for the past six months. The industry will therefore be an important factor in steadying the labor situation.

CONDUIT.—No change in price has been noted in black and white rigid conduit, although buyers are holding off looking for a shading in prices any day. The trade is cognizant, however, that the demand for steel in general will have a big effect on conduit prices. Manufacturers report freer shipments in taking care of the present demand. Southeastern stocks are very low, but this is accounted for by the fact that purchasers are now hesitating and that rigid restrictions a few months ago prevented any accumulations. This condition exists as well for the flexible-steel product, with slight exceptions. The call for flexible conduit is off when compared with the volume transacted in December, 1917, but about normal taking the five-year average into consideration.

FLEXIBLE-STEEL ARMORED CABLE.—The manufacturers are beginning to catch up and ship many back orders that they were unable to do anything with prior to Nov. 1. There has been no change in price since Sept. 1. At the present time stocks are getting in good shape and are about 75 per cent of normal. Deliveries are much easier.

STAMPED-STEEL BOXES.—The market for these is very sluggish. Prices are steady, and big stocks are on hand. A feeling exists that prices on this product may weaken in the face of ample stocks and slow movement.

FITTINGS.—Stocks are ample, and the demand is naturally following very closely the trend of other steel products.

PANELBOARDS AND CABINETS.—Present scattered buying places the present-day volume of sales on the basis of 30 per cent of normal. Prices remain steady. With the accumulation in the building trades, manufacturers are looking forward to a substantial volume of business this year.

SEATTLE—PORTLAND

A singular combination of confidence and perplexity prevails among jobbers of electrical merchandise in the Northwest, particularly in Seattle and Tacoma. The perplexity naturally is occasioned by unsettled conditions along several lines, especially lumbering. At present mills and logging camps employing thousands of men are closed down for the holiday season and annual repairs. This is the usual situation at this time, but it is persistently rumored that a large number of the mills and camps will not reopen until the industry is on a more stable basis. However, both jobbers and dealers have completed a year of active business and are hopefully anticipating that the coming year will show up equally well. Puget Sound cities, Seattle in particular, enjoyed a holiday business far in excess of the most optimistic predictions. Electrical purchases this year were confined almost exclusively to domestic appliances. Washing machines, percolators, toasters and sewing machines were the leaders. Few electrical novelties were sold. Local jobbers are now settling back in the usual after-holiday lull, which is expected to continue for a week or more. Small dealers are also experiencing the after effects of holiday business.

Reports from Spokane covering the week prior to Christmas state that the wholesale trade is fair and collections very good. Tacoma reports wholesale trade fair and retail business good, due largely to a good holiday business. Portland states that holiday buying was active. A report covering Oregon cities, not including Portland, says that Christmas trade this year far exceeded that of any other season for the past twenty-five years.

The validity of the five-million-dollar port bond issue voted in Portland at the November election has been assured. Portland wooden shipyards are making preparations to meet the expected demand for wood tonnage from foreign sources. General contractors and other authorities are of the opinion that building costs will continue high and will not materially decrease for at least one year. In spite of excessive costs, building is proceeding without noticeable diminishment in Puget Sound cities and in Portland. The Pheasant Northwest Products Company of Salem, Ore., is completing an addition to its plant which will be motor-driven.

SAN FRANCISCO

The general opinion of the electrical fraternity on the Pacific Coast is that 1919 will be a poorer electrical year as regards industrial sources, a better year for central-station business because heavy winter rains are decreasing the possibility of drought and releasing considerable electrical energy for other work, a poorer year, naturally, for government business, and a better year for railroad business as the better conditions of Eastern factories will enable them to turn out needed material for railroad maintenance and reconstruction; but, best of all, 1919 promises to be a wonderful year for the electrical dealers and contractors' business. War-essential boards are now passing very liberally upon new construction that was formerly deemed non-essential; wages are still at their higher standard, and there will not be so many patriotic calls upon the public as there were last year, when war was still being waged.

WIRING DEVICES.—Provided that the factories will make good delivery, this business will be far beyond the sub-normal year of 1918. Most of the construction will be in the nature of dwellings, apartment houses, office buildings, etc., requiring big quantities of wiring devices of various kinds.

INTERPHONES.—The housing situation is very serious at the present time. Practically every Pacific Coast city is deficient in facilities for housing its present population, to say nothing of any expected increase. While there are plenty of flats and old cottages to let, it is noticeable that apartment houses are eagerly snapped up. It is reported that the architects have plenty of projected apartments ready for the owners' permission to go ahead. All this means that interphones, or connecting telephones for such buildings, will be sold in large numbers provided that the factories can quickly finish their government work and get out these private devices. Shrewd San Francisco observers predict, within the next few months, a business in interphones, annunciators, etc., comparable only to that which followed the 1906 fire, when there was an unprecedented increase in building.

FARM PLANTS.—All parts of California are now being eagerly canvassed in the interests of these plants, and it is safe to say that the missionary work is practically completed and that there will henceforth be a steady demand for them.

HEATING DEVICES.—Although badly hampered by exceedingly poor deliveries from the factory, the Pacific Coast experienced the best holiday business in its history, and it was noticeable that higher-priced devices, such as chafing dishes and percolators and certain sick aids such as heating pads and radiators, were all sold up to stock limits.

Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+30% to +20%
Coil to 1000 ft	List
	No. 12 Solid
Less than coil	+30% to +20%
Coil to 1000 ft	List

Twin-Conductor

	No. 14 Solid
Less than coil	$115.00
Coil to 1000 ft	100.00
	No. 12 Solid
Less than coil	+30% to +20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 30%

BATTERIES, DRY
NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
2 to 50	.40	.40—.41
50 to barrel	.35—.36	.36—.37
Barrel lots	.32—.329	.33—.339

BATTERIES, DRY—Continued
CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40 to $0.45	$0.40 to $0.45
12 to 50	.35 to .38	.35 to .38
50 to barrel	.319 to .35	.329 to .35
Barrel lots	.289 to .32	.299 to .32

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅜	250	$5.00
½	250	7.50
⅝	100	10.00
¾	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single trip.	$75.00	$63.75— 69.75
⅜-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.25 to $63.75
⅜-in. double strip	78.25 to $78.75	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00	95.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
⅜	$0.05½	1	$0.25
½	.06	1¼	.33
⅝	.09	1½	.40
¾	.12	1¾	.47
⅞	.15	2	.55
¼	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$25.00–50.70	$24.60–35.20	$23.00–30.25
½-in.—	30.00–56.40	28.00–38.40	26.00–33.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$60.00	$30.00	$26.00–29.15
½-in.—	65.00	33.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
⅛	$0.08½
¼	.08½
⅜	.08½
½	.11½
¾	.17
1	.23
1¼	.27½
1½	.37½
2	.58½
2½	.76½
3	

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
⅛	$0.05	$0.19
¼	.06	.19
⅜	.07	.19
½	.10	.25
¾	.13	.37
1	.17	.45
1¼	.21	.50
1½	.28	1.10
2	.40	1.80
2½	.60	4.80
3		

DISCOUNT—NEW YORK

	⅛ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	7% to 7.1%	9% to 9.1%
2500 to 5000 lb.	10.1% to 20%	12.1% to 31%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	⅛ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+5.5% to 3.5%	+3.5% to +1.5%
2500 to 5000 lb.	+2.5% to +0.5%	+5% to 1.5%

(For galvanized deduct six points from above discounts.)

FLATIRONS
NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.00 to $7.00
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List, each, $0.07

LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List, Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted:		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.68
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg	List
Std. pkg	10%

DISCOUNT—CHICAGO

Less than std. pkg	List
Std. pkg	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.47—$40.77
Coil to 1000 ft	27.42— 32.98

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$38.00
Coil to 1000 ft	28.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$24.00 to $33.00

CHICAGO

Net per 100	$23.93 to $30.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 620, 320	$30.00
102—B.A., 6200, S.E., 350, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%	20%
$10.00 to $50.00 list	36%	31%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%	10%
$10.00 to $50.00 list	30%	20%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	5%
1/5 to std. pkg	15%
Std. pkg	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg	$20.00 to $21.00
1/5 to std. pkg	17.00 to 17.85

Standard package, 2200. List per 1000, $21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg	$21.00
1/5 to std. pkg	17.85

Standard package, 2200. List per 1000, $20.00–21.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500	Std. Pkg. 4000 5½ N.C.—Solid Nail-it—N.C.
Less than 1/5 std. pkg	$16.00—$32.00	
1/5 to std. pkg	13.60— 27.20	

CHICAGO

Per 1000 Net.	Std. Pkg. 3500	Std. Pkg. 4000 5½ N.C.—Solid Nail-it—N.C.
Less than 1/5 std. pkg	$13.00—$32.00	
1/5 to std. pkg	11.50— 27.20	

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	List
1/5 std. pkg	10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T	$0.80
60-amp. S. P. S. T	1.20
100-amp. S. P. S. T	2.25
200-amp. S. P. S. T	3.48
300-amp. S. P. S. T	5.34
30-amp. D. P. S. T	1.20
60-amp. D. P. S. T	1.78
100-amp. D. P. S. T	3.38
200-amp. D. P. S. T	5.20
300-amp. D. P. S. T	8.00
30-amp. 3 P. S. T	1.80
60-amp. 3 P. S. T	2.68
100-amp. 3 P. S. T	5.08
200-amp. 3 P. S. T	7.80
300-amp. 3 P. S. T	12.00
Low Grade:	
30-amp. S. P. S. T	$0.42
60-amp. S. P. S. T	.74
100-amp. S. P. S. T	1.50
200-amp. S. P. S. T	2.70
30-amp. D. P. S. T	.68
60-amp. D. P. S. T	1.22
100-amp. D. P. S. T	2.50
200-amp. D. P. S. T	4.50
30-amp. 3 P. S. T	1.02
60-amp. 3 P. S. T	1.84
100-amp. 3 P. S. T	3.76
200-amp. 3 P. S. T	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15% to +10%
$10 to $25 list	2% to 5%
$25 to $50 list	5% to 10%
	Low Grade
Less than $10 list	+5% to list
$10 to $25 list	8% to 15%
$25 to $50 list	15% to 20%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+ 15%
$10 to $25 list	List to 2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15% to 16%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	List to 10%
1/5 to std. pkg	10% to 16⅔%
Std. pkg	18% to 25%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	Net to 18%	Net
$2.00 to $10.00 list	10% to 28%	5%
$10.00 to $50.00 list	20% to 45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.50 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.55–$0.66
No. 18, full spools	.53– .56

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.65 to $0.75
No. 18, full spools	.55 to .635

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$20.00–$25.00	$13.50–$17.00	$12.50–$15.00
12	25.00– 27.09	22.50– 23.22	18.75– 23.22
10	31.26– 32.40	28.66– 32.40	25.00– 27.45
8	43.92– 45.72	40.26– 45.72	35.14– 38.10
6	63.69– 72.36	57.90– 60.30	55.58– 57.88

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$25.00	$18.00–$25.00	$15.50
12	$29.46– 31.44	29.46– 31.44	$25.54– 31.44
10	41.10– 43.84	41.10– 43.84	34.62– 38.36
8	57.00– 61.76	57.00– 61.76	50.18– 54.04
6	85.31– 97.68	85.31– 85.47	77.21– 85.47

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$39.75
25 to 50 lb	39.75
50 to 100 lb	38.75

CHICAGO

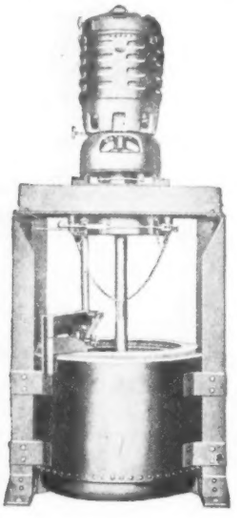
	Per 100 Lb. Net
Less than 25 lb	$39.76 to $41.00
25 to 50 lb	38.76 to 40.00
50 to 100 lb	37.76 to 39.00

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Centrifugal Machines with Direct-Connected Motors

Centrifugal machines are used for expelling water or other liquids from moist substances or for separating liquids of different densities. In the salt and sugar industry they find particular application. Because their position does not have to be limited by



SQUIRREL-CAGE MOTOR DIRECTLY CONNECTED TO CENTRIFUGAL MACHINE

proximity to the boiler house for steam economy and because there are no belts to tighten and maintain it is very desirable to have these machines directly driven by an electric motor. However, there have been many difficult problems to be overcome in applying motor drive to this service. The centrifugal spindle must be allowed to swing, whereas the motor must be rigidly supported unless a cumbersome bearing is designed to carry this combined weight. Also a centrifugal machine requires very high starting torque. It is likewise pointed out that alternating current is usually available, and this does not lend itself as readily as direct current to motors operating at all speeds from 0 to 1200 r.p.m. A flexible coupling is therefore necessary between the shaft of the motor and the spindle of the centrifugal machine itself. Moreover, either a motor with a slip-ring rotor and external resistance must be provided or else a clutch in addition to the flexible coupling, so that the motor may come up to speed and then run at a speed where it can develop the necessary torque.

In the new "Mackintosh" centrifugal machines being manufactured by the S. S. Hepworth Company of 2 Rector Street, New York City, a high-resistance squirrel-cage motor is employed, being equipped with a centrifugal clutch that acts both as a flexible coupling and as a clutch. A light fork is attached to the motor shaft, revolving with it. The centrifugal force throws the blocks between these arms outward, gripping the rim of the friction drum with increasing force as the blocks revolve faster until a balance is attained between the motor torque and the friction grip on the drum. This, the manufacturer states, makes the motor simple and dependable without brushes or commutators, slip rings, solenoids or resistances and the consequent expense and difficulty which would be necessary to keep these in adjustment.

In the motor used on these centrifugals the bearings are so arranged that by lifting the motor up, without even releasing it from the slings, access is immediately possible to the bearings. These can all be replaced without taking out the rotor or other parts of the mechanism. A special feature of the Mackintosh centrifugal machines is that the motor is arranged to run at two speeds. The high speed is used for drying the material and the low speed for unloading, which has been considered the hardest portion of an operator's work but which is said to be now rendered very easy. An important difficulty in centrifugal machine operation has been the tendency of the basket to swing. To overcome this tendency the "Mackintosh" employs a suspension which effectively holds the center of the spindle close to the axis of rotation but uses no springs, buffers or other elastic members.

Dishwasher for Limited Quarters

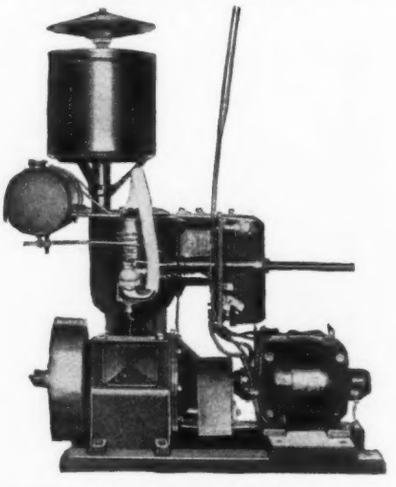
The latest addition to the line of electrically operated dishwashing machines made by the Insinger Company, Inc., Philadelphia, is its model No. 5, which is said to be especially adapted for use in hotels and restaurants where space is at a premium. The machine is 36 in. (0.9 m.) by 18 in. (0.45 m.) and has a capacity of 3000 dishes per hour. The motor used is rated at ¼ hp. and is connected to the paddles in the cast-iron tank by belt drive. In operating the washer, dishes are placed in a basket which is lowered by a traveling crane into the hot washing water agitated by the electrically driven paddles or propellers. After a few seconds in this water the basket of dishes is raised and then lowered for a similar period into the second compartment of the tank, which contains the rinsing water. The basket is then raised and allowed to stand a few seconds while the dishes dry, thus making wiping unnecessary.

Automatic Farm Power and Lighting Plant

The "Alco" farm lighting and power plant, which uses a battery only for starting purposes and which generates 110 volts, has been placed upon the market by the Automatic Light Company of Minneapolis, Minn. The unit is compact, light in weight and automatic in its operation.

An advantage claimed for the plant is that not only does the standard 110-voltage permit distribution at nominal loss for longer distances than with low-voltage systems, but lamps, motors and other appliance, being for standard voltage, cost less than if the plant had a different voltage; they can also be repaired with greater ease. Eliminating a storage battery means lower first cost and lower plant upkeep expense, says the manufacturer.

The single-cylinder, four-cycle, valve-in-the-head engine used, which operates on gasoline, is water-cooled by a



COMPACT AND USING A BATTERY ONLY FOR STARTING

percolator system said to require only 4 gal. of water and to keep the cylinder temperature between 230 deg. and 240 deg. Fahr. (110 deg. to 115 deg. C.) A specially designed General Electric

generator is used, having a 110-volt winding on its light and power end and 7½ volts on the other end, which is used as a motor in starting the plant from a standard 6-volt starting battery. A relay, two electromagnets and an automatic cut-out to protect the starting battery should the gasoline tank be empty are provided.

When the switch controlling a light or appliance connected to the plant is turned on the circuit of the relay is closed. This in turn closes the switch on the 6-volt starting motor, which then starts the gasoline engine. When 90 volts have been reached the starting current is cut off and the 110-volt circuit is cut in. This latter operation is reversed when the lamp or power appliance has been turned off, and the plant then stops.

One of the novel features of the "Alco" plant is pointed out by the manufacturer to be the voltage regulation. This is accomplished by an electric solenoid governor which acts directly on the throttle of the carburetor without any intervening cams, levers or springs, opening and closing it to take care of the slightest voltage variations, thus producing a steady, flickerless light direct from the generator. Another feature of the plant is the high overload capacity of the generator.

Portable Light-Weight Drill

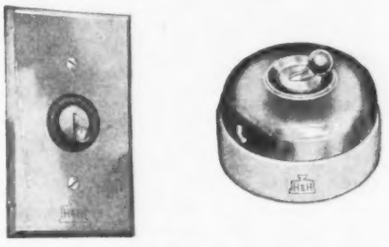
A new-size drill has been added to the line of portable electric drills made with pistol grips and trigger switches

EASY CONTROL PROVIDED BY PISTOL GRIP AND TRIGGER SWITCH

by the Black & Decker Manufacturing Company of Baltimore, Md. The removable taper socket with which this drill is equipped makes it possible to use taper shank drills up to ⅞ in. (2.2 cm.) in diameter. Weighing but 27 lb. (12.2 kg.), the drill is 5¼ in. (13.3 cm.) in width, 17 in. (43 cm.) long and has an offset spindle 2⅜ in. (6 cm.) from the spindle's center to the edge of the frame. A maximum output of ½ hp. is delivered by a light-weight, series-compensated motor, which has a plug for lamp-socket insertion. Because of its light weight and automatic control the makers claim for this drill adaptability to a wide variety of work.

Flush and Surface Tumbler Switches

Handles and covers of surface switches frequently drop off or are maliciously removed, causing considerable



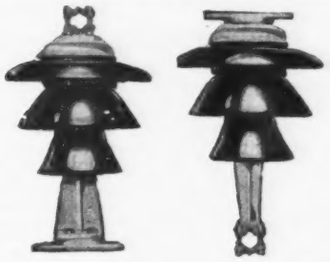
INSULATING RING ON FLUSH TYPE PROVIDES ADDED INSULATION

annoyance and inconvenience. The new surface-type tumbler switches being made by the Hart & Hegeman Manufacturing Company of Hartford, Conn., are designed to eliminate trouble of this nature. The arching shape of the cover helps to protect the mechanism from injury as well as adding to the attractive appearance of the switch.

The maker suggests that this switch will be particularly suitable for installation in manufacturing plants where severe usage is frequently encountered. Two styles of cover plates are furnished for the new flush-type tumbler switches also being marketed by this company. One has ornamental embossing around the center, while the other has a center ring, furnishing additional insulation for the plate. These switches are supplied in single-pole or three-way types with ratings of 3 amp., 250 volts, or 5 amp., 125 volts, and 5 amp., 125 volts, or 10 amp., 125 volts. Polished brass is the standard cover finish used on the surface type and on the flush style brushed brass is supplied.

Unit-Type Outdoor Busbar and Wiring Supports

Interchangeable unit-type supports for outdoor substations making use of high-tension buses have just been de-



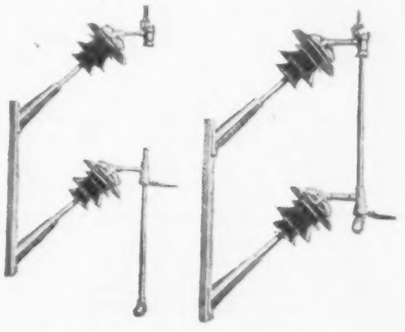
FOR UPRIGHT OR SUSPENDED BUSBARS

veloped by the Delta-Star Electric Company, 2433 Fulton Street, Chicago. These supports are adjustable for top and bottom fastening and enable the conductors to be run at any desired angle. In one size of these supports two slots are provided for ½-in. (1.3-cm.) bolts, permitting a minimum distance of 5¼ in. (13 cm.) and a maximum of 5⅜ in. (13.6 cm.) between them. In a larger size the holes for ⅝-in. (1.6-cm.) bolts are spaced 6½ in. (16.5 cm.) apart.

Outdoor-Type High-Voltage Disconnecting Switch

A plunger-type outdoor disconnecting switch for high voltages and designed for great rigidity with little weight has recently been placed upon the market by Hickey & Schneider of Elizabeth, N. J. Being of the plunger type, the switch is easily operated, a hook inserted into an eye at the lower end of the plunger pulling the latter down into the open position, while to close the switch the plunger is simply pushed up. An automatic lock is used to hold the switch securely in closed position.

A notable feature claimed by the manufacturers is the complete protection from the weather afforded to the contact parts. Any sleet that may form on the plunger while the switch is in an open position will be shaved



SLEET IS SHAVED OFF BEFORE PLUNGER ENGAGES CONTACTS

off when the plunger passes through the neck of the upper contact bell so that it is perfectly clean when engaging the contacts situated in the upper part of the bell. Since the contacts in the upper and lower bells are self-aligning, a perfect electrical contact is said to be always assured.

The insulators are mounted at an angle of 45 deg. to the vertical, thus putting them in the nearest position to the correct vertical one. This outdoor switch is built for all voltages, while in the style for indoor service the post-type insulators are mounted at an angle of 90 deg. to the vertical.

Notice to Manufacturers

The "Electrical World" is living up to the letter of the Post Office Department ruling outlined on the New Apparatus page of the issue of Nov. 16. Manufacturers must do their part by sending descriptions of new products in advance of date of general publicity.

Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A representative of a French syndicate (No. 27,817), who is at present in this country, desires to purchase and secure an agency for electrical apparatus and supplies.

A man in Canada (No. 27,833) desires to represent manufacturers of electrical specialties.

A commercial agent in New Zealand (No. 27,845) desires to secure the representation of manufacturers and exporters for the sale of electric torches and batteries.

A man in England of Belgian descent (No. 27,865) wishes to obtain an agency for the sale of gas and electric fittings and motors throughout Belgium.

Agencies (27,868) are desired from American manufacturers and exporters for the sale in France of electrical material, steam fittings, etc.

There is a shortage of electrical supplies in Norway, it is reported by Consul Ralph C. Busser, Bergen, Norway, as imports from Germany, Great Britain and the United States have not yet been resumed and there are difficulties in importing them from Sweden. The domestic industry is hampered by lack of raw materials, fittings, etc. During the past six months prices of general electric supplies have advanced 30 to 40 per cent, and of luxuries such as electric chandeliers up to 70 per cent.

A man in Italy (No. 27,903) desires to purchase and secure an exclusive agency for the sale of incandescent-lamp bulbs with screw mountings. Quotations to be made f.o.b. New York, cash (United States currency) against documents; English correspondence.

A man in Italy (No. 27,888) desires to purchase nitrogen lamps for medical light and heat baths and metals of high electric resistance. Correspondence should be in Italian.

A new firm (No. 27,859), recently established by two government officials in Italy, desires to secure an agency on commission for the sale, among other things, of electrical machinery and apparatus.

GROWTH OF ROBBINS & MYERS.—Four years ago last month, on Dec. 12, 1914, the Robbins & Myers Company, Springfield, Ohio, was almost wiped out by fire. Since that time the company has grown very rapidly, the number of employees increasing from 1000 to three times that number. New and modern buildings have replaced those destroyed.

THE LYONS SAMPLE FAIR OF 1919.—In view of present conditions American participation in the fourth international sample fair, which is to be held at Lyons, France, from March 1 to 15, 1919, becomes increasingly desirable and important. The Department of State has allotted to the American consul at Lyons $1,000 for the rental of space at the fair for the display of American goods and catalogs, following a precedent established in recent years. As a result three ways are open to manufacturers and exporters of the United States in which to exhibit at this fair: (1) A stand or several stands may be rented. The area of each stand is about 20 sq.yd., and the rental for the duration of the fair is 600 francs ($116 at normal exchange); (2) samples may be exhibited in the official consulate stand on payment of a fee to the fair committee of $25 for the privilege, or (3) catalogs may be shown in the consular stand free of charge. The consul and his staff will endeavor to give the widest publicity to these catalogs. Each prospective exhibitor is required to fill out and sign an entry form, a copy of which may be obtained from the Bureau of Foreign and Domestic Commerce at Washington. Under no circumstances will any exhibits be shown unless the necessary forms are signed. Manufacturers and exporters desiring to exhibit under plan (1) above should write at once to the Comité de la Foire, Hotel de Ville, Lyons, France, giving complete information as to the character of their exhibit and inclosing the necessary fee for the stand or stands engaged. If, on the other hand, a manufacturer desires to be represented by catalog or sample in the consular stand under plan (2) or (3), this fact should be immediately communicated to the American consul at Lyons, France, and, if samples are to be exhibited, the necessary fee sent him.

V. I. SMART, formerly professor of railway engineering and transportation at McGill University, Montreal, and J. A. Burnett, formerly electrical engineer with the Grand Trunk Railway system, are now associated as consulting engineers at the New Birks Building, Montreal. The lines handled will be civil, electrical and mechanical, engineering.

THE BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY at a meeting held on Nov. 20 voted to increase the capital stock by $25,000,000, $5,000,000 of which will be issued at the present time and perhaps another $5,000,000 within a year. The formation of subsidiary undertakings at home and abroad was proposed. The increase in capital is necessary for developing the business. There are certain experimental works that will take large sums, it is understood.

THE FULLER ENGINEERING COMPANY, designing and constructing engineers, Allentown National Bank Building, Allentown, Pa., announces that Frederick A. Scheffler, formerly connected with the New York offices of the Babcock & Wilcox Company, has now become associated with it and will make his headquarters at its New York office, 50 Church Street. The Fuller Engineering Company is making a speciality of applying the pulverized-coal method of firing to boilers of all kinds for generating power, and Mr. Scheffler will be in a position to furnish complete information regarding the cost of installation, preparation and probable economies obtainable by the adoption of this method of firing coal.

E. S. LINCOLN, INC., of Portland, Me., was enlarged on Jan. 1 and is now known as Lincoln, Hanson & Abbott, Inc. The two new partners were formerly with the Moulton Engineering Corporation, which has given up its Portland office, and one of them, Major Abbott, has just returned from service with the engineers in France. The new firm will occupy the same offices but will enlarge the scope of its work so as to cover civil, mechanical, hydraulic and electrochemical engineering in addition to electrical engineering. The firm proposes to go into the business of consulting and designing engineering and management of properties with renewed energy now that the great war is over. The Electrical Standardizing Laboratories will be retained and enlarged, leading to greater activities than have been possible in the past.

LAMP EXPORTS FOR OCTOBER.—Statistics just compiled by the Bureau of Foreign and Domestic Commerce show the exports of electric incandescent lamps during the month of October to have been slightly less than $200,000, as follows: Six arc lamps, valued at $273; 28,388 carbon lamps, valued at $5,758, and 769,657 tungsten lamps, valued at $191,344. Canada, which was the largest receiver of these goods, took practically 10,000 carbon lamps and more than 160,000 tungsten lamps. About 500,000 of the tungsten lamps went to Central and South America. Italy took the greatest number of lamps in Europe, namely, 20,000, all others taking under 1000 lamps. It is interesting to note that roughly 40,000 lamps went to British India and slightly more than 35,000 lamps to the Philippine Islands.

RE-EMPLOYMENT OF MEN DISCHARGED FROM SERVICE.—The Pittsfield Works of the General Electric Company have arranged for the reëmployment of men returning from the service as follows: (1) Those who return from military or naval service and who apply for reinstatement will be placed if possible in positions in the department, office or works that they left in order to enter the service; (2) such reëmployment to be limited to men who have been honorably discharged from military and naval service and, except in special cases, who apply for reëmployment within sixty days from the date of such discharge; (3) those who return direct from military or naval service to the company's employ, without accepting employment elsewhere, will be given credit for continuity of service in the company's employment record, including the length of time spent in military or naval service, as though they had worked continuously for the company during that period; (4) compensation of men so reëmployed shall be the current rate paid to employees engaged in similar work at the date of reëmployment; (5) the reëmployment of men disabled in military service will be directed by committees to be appointed.

Trade Publications

MARINE FIXTURES.—Its line of marine electric fixtures is described in an eighteen-page catalog, No. 15, issued by the Seidler-Miner Company, Detroit, Mich.

RECHARGEABLE DRY BATTERY.—A booklet has been issued by the Stolp Company of 2210 South Park Avenue, Chicago, on the "Maxilife" rechargeable dry battery.

LIGHTING FIXTURES. — The Trop Specialties Company, 1834 Broadway, New York City, is distributing a folder about its "Tropiolite" and "Deadlite" lighting units.

DRY BATTERY.—The Standard No. 6 dry battery marketed by the Williamson Electric Company, 696 Jamaica Avenue, Brooklyn, N. Y., is described in a recently prepared folder.

CABLE FAULT FINDER.—A four-page circular about their cable fault-finding apparatus, which uses a high potential and high frequency discharge, has been printed by Norman Stell & Company, Bradford, England.

DISHWASHER.—Four models of the "Victor" motor-driven dishwashing machines are described in an illustrated four-page circular from Louis A. Haustetter, Locust Avenue and East Sixteenth Street, Brooklyn, N. Y.

METERS.—"The Esterline Graphic," issued by the Esterline Company of Indianapolis, contains general announcements on type MS graphic recording instruments, type MS portable graphic recording power-factor meters and type W duplex indicating instruments.

ENGINE.—Bulletin 34-W issued by the Chicago Pneumatic Tool Company, Fisher Building, Chicago, deals with the "Giant" semi-Diesel engines. Low fuel oil may be used in these engines, which are of the horizontal type, use a cross-head and have a hot plate instead of a hot ball or electric ignition for starting purposes.

New Incorporations

THE NICHOLS ELECTRIC COMPANY of Bennington, Vt., has been chartered with a capital stock of $5,000 by William H. Inez, M. R. Nichols, Whitney Nichols and E. H. Holden of Bennington.

THE CENTRAL CONDUIT COMPANY of Wilmington, Del., has been incorporated by M. L. Horty, J. D. Frock and M. A. Denver of Wilmington, Del. The company is capitalized at $100,000, and proposes to build and lay conduits.

THE ONTARIO ELECTRIC STEEL COMPANY of Fulton, N. Y., has been chartered with a capital stock of $1,000,000. The directors are: Carl Ehlermann, Jr., Donald R. Abbiott and Frederick W. Jockel, all of 61 William Street, New York.

THE RENEW ELECTRIC LAMP COMPANY, of Wilmington, Del., has been incorporated by C. B. Bishop, A. M. Fox and S. H. Baynard, Jr., of Wilmington, Del. The company is capitalized at $100,000, and proposes to manufacture electric lighting devices and to operate electric light plants.

THE WOOLFOLK ENGINEERING & SUPPLY COMPANY of Rutherford, N. J., has been incorporated by Edward G. Woolfolk and Frances A. Woolfolk of Rutherford and Edward G. Woolfolk, Jr., of New York. The company is capitalized at $125,000, and proposes to do a general contracting business.

THE TITAN FURNACE COMPANY of Buffalo, N. Y., has been incorporated with a capital stock of $100,000 to construct boilers, furnace, heating and power plants. The incorporators are: M. W. Comstock, 39 Erie Street; G. S. Kent, 85 Winslow Avenue, Buffalo, and F. F. Williams, 904 D. S. Morgan Building, Buffalo, N. Y.

THE NIAGARA-FRENCH BATTERY COMPANY, 161 Ogden Street, Newark, N. J., has been incorporated with a capital stock of $125,000 to manufacture electrical batteries, appliances and novelties. The incorporators are: Herbert M. Lloyd, 24 Lloyd Road, Montclair; Raymond E. Cook, 419 West 115th Street, New York, N. Y., and Ransom Noble, 304 West Seventy-seventh Street, New York.

New England States

RUTLAND, VT.—The boiler plant and electrical department of the Rauber Rytenburg Shirt Company was recently destroyed by fire, causing a loss of about $25,000.

NATICK, MASS.—Work has begun on the construction of an automobile factory for the Northway Motors Corporation in Natick. The building will be one story, 200 ft. by 600 ft.

PEABODY, MASS.—The Hunt & Rankin Leather Company is building a power plant, 50 ft. by 50 ft., one story, at its plant in Peabody.

WATERBURY, CONN.—The Waterbury & Bristol Tramway Company is contemplating extending its electric railway from South Street, Bristol, over Wolcott Street and through Wolcott, connecting with the car line from Waterbury to Hotchkiss Lake. For further information address J. H. Cassidy, 144 Bank Street, Waterbury.

Middle Atlantic States

BLACK RIVER, N. Y.—Temporary electrical service, pending the installation of new electrical equipment at the local plant, operated under the auspices of the St. Regis Paper Company, is being furnished by the Northern New York Utilities, Inc., of Watertown, in Black River and vicinity.

BROOKLYN, N. Y.—The Department of Water Supply, Gas and Electricity will take over the lighting in Borough Park Heights. Electric lamps of 400 cp. will be erected on several streets.

BROOKLYN, N. Y.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Jan. 13, under Specification 3599, for elevator and dumbwaiter in building D at the Brooklyn Navy Yard. The cost is estimated at $3,500.

BUFFALO, N. Y.—The Perfect Fuse Company has increased its capital stock from $100,000 to $200,000, the proceeds to be used for extensions. The company manufactures fuses and kindred specialties.

BUFFALO, N. Y.—Work has begun on the construction of an addition to the boiler plant of the Pierce Arrow Car Company, 1695 Elmwood Avenue, to cost about $300,000. The Stone & Webster Company, Electric Building, has charge of the work.

BUFFALO, N. Y.—Plans are under consideration by the Marine Elevator Company, Chamber of Commerce Building, for the construction of a new electrically operated grain elevator at the foot of Childs Street. An electric power plant will be erected in connection with the project. The cost of the entire plant is estimated at $1,000,000.

CLEVELAND, N. Y.—The engine department at the power plant of E. Moreness & Company and a section of the factory was destroyed by fire recently, causing a loss of about $15,000. The company manufactures thermometers.

ITHACA, N. Y.—The electric power plant of the Ithaca Traction Company was destroyed by fire on Dec. 20, causing a loss of about $75,000. The plant has supplied electricity for operating the railway system and for local lighting service, and will be rebuilt immediately.

NEW HAMPTON, N. Y.—Arrangements are being made by the Department of Corrections, Municipal Building, New York City, for the construction of a new power house at the New York City Reformatory in New Hampton.

NEW YORK, N. Y.—The capital stock of the Reliance Electric Inspection Company, 241 West Twentieth Street, has been increased from $5,000 to $50,000, the proceeds to be used for expansion.

NEW YORK, N. Y.—Plans have been completed by M. Groh's Sons, Inc., 238 West Twenty-eighth Street, for the erection of a ten-story cold-storage plant at 245-51 West Twenty-seventh Street, to cost about $250,000.

NIAGARA FALLS, N. Y.—The Niagara Falls Power Company is building a new three-story substation, 100 ft. by 158 ft., to cost about $35,000.

RICHMONDVILLE, N. Y.—At an election held recently the proposal to raise an additional $5,000 to complete the electric lighting plant was carried.

SONYEA, N. Y.—Bids will be received by Percy L. Lang, president of board of managers, Craig Colony for Epileptics, Sonyea, until Jan. 14, for construction of dining room and kitchen buildings, West Group, Craig Colony for Epileptics, including heating, plumbing and electric work. Drawings, specifications and blank forms may be consulted at the above institution at Sonyea, at the New York Office of the Department of Architecture, 1715 Tribune Building, and at the Department of Architecture, Albany. Lewis F. Pilcher, Capitol, Albany, is state architect.

UTICA, N. Y.—The installation of new boiler equipment at the Utica State Hospital is reported to be under consideration by the State Hospital Commission.

UTICA, N. Y.—Preliminary plans are being prepared by H. P. Knowles, architect, 52 Vanderbilt Avenue, New York City, for the erection of a hospital for the Masonic Order, 46 West Twenty-fourth Street, New York City, at Utica, to cost between $400,000 and $1,000,000.

VERONA, N. Y.—The Adirondack Electric Power Corporation of Glens Falls has petitioned the Public Service Commission for permission to construct and operate an electric power plant in Verona.

AMPERE, N. J.—Plans are being prepared by the Crocker-Wheeler Company of Ampere for an addition to its boiler room and power house, 40 ft. by 55 ft., known as plant 8-A.

HARRISON, N. J.—The Edison Lamps Works of the General Electric Company, Sussex Street, Harrison, is reported to be considering the erection of a new plant on a site recently acquired at Frelinghuysen and Evergreen Avenues, Newark.

JERSEY CITY, N. J.—Plans are being considered by the City Commission for the construction of a boiler and engine room on the City Hospital grounds.

NEWARK, N. J.—Plans have been prepared by F. A. Phelps, architect, 920 Union Building, for a silk mill, 52 ft. by 213 ft., four stories, and power house, 100 ft. by 120 ft., one story, on Purdy and O'Dell Streets, to cost about $75,000.

NEWARK, N. J.—The Wilson Building at Lawrence and Mechanic Streets, occupied by a number of industrial concerns, was recently destroyed by fire, causing a loss of about $60,000. Among the companies that occupied the building are Felzenberg Brothers, manufacturers of electric and gas fixtures, the Dual Welding Apparatus Company and the American Art Metal Company.

PATERSON, N. J.—Plans are under consideration by the Public Service Electric Company for the installation of new electric lamps in the borough of Prospect Park, replacing a number of installations now in use.

SOMERVILLE, N. J.—The construction of a new electric railway to extend from Somerville to Bernardsville to develop the extensive holdings of the Schwartz-Hermann Steel Works north of Somerville and to open up the country further north is reported to be under consideration. Louis Schwartz, president of the steel company, is reported interested in the project.

BROWNSVILLE, PA.—The boiler plant, machine shop and other buildings, including electric and operating equipment, at the Pike mine of the Diamond Coal Company were recently destroyed by fire, causing a loss of about $50,000.

CORAOPOLIS, PA.—A site of about 25 acres has been acquired in Coraopolis by the Montour Railroad Company of Pittsburgh, a portion of which will be used for the construction of a new car manufacturing plant, including shops, wheel works and other buildings.

HARRISBURG, PA.—The Harrisburg Electric Supply Company, 24 South Second Street, is planning to make alterations and improvements to its building on Chestnut Street near Second Street, to cost about $10,000.

PHILADELPHIA, PA.—The Philadelphia Rapid Transit Company is contemplating the construction of an addition to its substation, to cost about $12,000.

PHILADELPHIA, PA. — Arrangements have been made by the Electrical Bureau for extending its conduit service during the coming year. With a return to peace conditions the proposed program to complete the large power plant at the City Hall will probably be carried out.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

WEATHERLY, PA.—Arrangements are being made by the Weatherly Electric Light Company to furnish additional service to the Weatherly Steel Company, which is increasing the capacity of its plant. Electrically operated machinery will be installed.

ELKTON, MD.—Plans are under consideration by the Scott Fertilizer Company for rebuilding its local plant, recently destroyed by fire. The loss, including machinery and equipment, is estimated at about $250,000.

BRISTOL, VA.-TENN.—The power house of the Bristol Gas & Electric Company was destroyed by fire on Dec. 29.

RICHMOND, VA.—The construction of a hydroelectric power plant in connection with a flour mill near Richmond is reported to be under consideration by the Shenandoah Milling Company, to cost about $350,000. Alfred M. Quick, Munsey Building, Baltimore, Md., is engineer.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 13, for construction of building and installing mechanical equipment and furnishing material for hygienic laboratory at Washington.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Eastern and Western yards, Schedule 3637—165,000 batteries for flashlights and 39,000 flashlights. F.o.b. works, Schedule 7600½—ventilating fans and spares; Schedule 7632½—fire airplane radio transmitting equipments. North Charleston, Schedule 3634½ — three air-compressors. Norfolk and Brooklyn, Schedule 7608½—five electric ranges. Mare Island, Schedule 7619½—5000 ft. portable cable. Philadelphia, Schedule 7625½—ten non-synchronous rotary spark gaps. Newport News, Va., and Camden, N. J., and also Washington, D. C., Schedule 7630½—miscellaneous electrical auxiliary gear-elevating equipment. Applications for proposal blanks should designate the schedule desired by number.

North Central States

BESSEMER, MICH.—Bids will be received about Feb. 1 by the Board of Education, Bessemer, for construction of school building and power house, to cost about $125,000. C. Anderson of Ironwood is architect.

DETROIT, MICH.—Plans are being prepared for the erection of an eight-story addition, 75 ft. by 100 ft., to the plant of Frederick Stearns & Company at Jefferson and Bellevue Avenue, to cost about $200,000.

DETROIT, MICH.—The General Motors Company is reported to be considering the erection of a plant to manufacture electric lighting and starting systems in Detroit. The company is also contemplating establishing a plant for producing a low-priced truck.

DETROIT, MICH.—Bids will be received by the Board of Education, 50 Broadway, until Jan. 9, for the construction of a school building on Emerson Avenue, south of Jefferson Avenue, to cost about $275,000. Malcolmson & Higginbotham, 404 Moffat Building, are architects.

JACKSON, MICH.—Arrangements have been made by the Consumers' Power Company for a bond issue of $5,334,000, the proceeds to be used for current operation, including extensions and betterments. The company operates plants at Grand Rapids, Saginaw, Kalamazoo, Battle Creek, Lansing, Cadillac, and other places in the State of Michigan.

BUCYRUS, OHIO.—The Ohio Gas & Electric Company of Middletown is reported to be considering the erection of a high-tension transmission line from its plant at the falls of the Sandusky River at Ballville through Crestline to supply electricity to the Pennsylvania Railroad shops and thence west to Bucyrus. Investigations are being made here by the company with a view of supplying electricity for street lighting as well as for industrial plants in Bucyrus. The present street-lighting contract expires next June.

COLUMBUS, OHIO.—Bids will be received at Columbus, Ohio, until Jan. 6, for remodeling Memorial Building, including lamps, fixtures, switchboard, theater dimmers, and new fixtures and lamps. For further information address W. J. Herman, clerk of county board.

LIMA, OHIO.—Plans for establishing an electric plant in Lima are under consideration by the city officials. The city has a bond issue of $56,808, authorized by a vote of the electors ten years ago for a lighting plant. It is believed by connecting the station with the municipal waterworks, where two generators are already in use, an expenditure of only about $100,000 would be necessary.

PIQUA, OHIO.—Preliminary steps have been taken by the City Council toward the installation of an ornamental street-lighting system as proposed by the Dayton Power & Light Company a year ago. The company has been authorized to begin work on Main Street from the Pennsylvania Railroad north to Green Street.

SANDUSKY, OHIO.—The original plans for improvements in the boiler plant of the Sandusky Gas & Electric Company have been revised to accommodate an additional 400-hp. boiler, which will be installed at once.

SANDUSKY, OHIO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 23, for wiring and lighting in the United States custom house and post office at Sandusky, Ohio. For details see Searchlight Section.

TOLEDO, OHIO.—The Standard Steel Tube Company, Fitchland Avenue and Detroit & Michigan Central Railroad, has purchased a site on South Detroit Avenue on which it proposes to erect a plant to cost about $500,000.

TOLEDO, OHIO.—The S. S. Royster Guano Company, Second National Bank Building, has purchased property adjoining its plant, on which, it is understood, it proposes to erect a sulphuric acid plant, at a cost of about $500,000.

WARREN, OHIO.—The Public Utilities Commission has granted the Trumbull Public Service Company permission to issue $1,200,000 in notes, the proceeds to be used for current expenses, general expansion and for reimbursements for improvements.

WELLSVILLE, OHIO.—Plans are under consideration by the Pennsylvania Lines West of Pittsburgh for the construction of new locomotive and car shops and new yard facilities at Wellsville, to cost more than $1,000,000.

JEFF, KY. — The Acup Creek Coal Company, recently organized, proposes to develop about 2000 acres of coal land. Electrically operated machinery will be installed. The proposed equipment will include two return tubular boilers, one 150-kw., 250-volt direct-current generating unit, directly connected; one 150-kw., 250-volt direct-current generator connected to a 225-kva., three-phase, 60-cycle, 2300-volt motor; 1100 ft. 1¼ P. S. rope, and 00 Fig. 8 trolley wire. Arthur L. Ware is president.

LOUISVILLE, KY.—Tuck & Company, 1113 West Main Street, are contemplating the installation of additional equipment in their power plant.

LOUISVILLE, KY. — The Louisville Board of Public Works in its annual report to Mayor Smith and the Council recommends that the city establish a municipal lighting plant to be operated in conjunction with the Louisville Water Company. The city is now paying the Louisville Gas & Electric Company $200,000 per year, and when lamps are furnished in additional territory just taken in the rate will be about $250,000 per year. It also recommends that lamp standards replace arc lamps on Broadway from Shawnee Park to Cherokee Park.

WHITCO, KY.—The Whitesburg Coal Company is contemplating the installation of new electrically operated machinery at its local properties.

KOKOMO, IND.—F. T. Morrissey, engineer, care of Indiana Railway & Lighting Company, Kokomo, is reported to be interested in a water power development.

AURORA, ILL. — Extensive improvements, it is reported, are contemplated by the Western United Gas & Electric Company.

CHICAGO, ILL.—Plans have been prepared by A. S. Alschuler, architect, 28 East Jackson Street, for the construction of an eight-story factory building, 150 ft. by 200 ft., on Harrison and Pauline Streets, for the Philipsborn Outer Garment Company, 900 West Van Buren Street. The cost is estimated at about $1,250,000.

ROCKFORD, ILL.—The Rockford City Traction Company is reported to be contemplating laying a double track on Seventh Street, between Third and Eleventh Avenue. The cost is estimated at $39,000.

WAUKEGAN, ILL.—The North Shore Electric Company is contemplating extending its lines to Greenwood Avenue.

EAU CLAIRE, WIS. — The Chippewa Power Company of Eau Claire, recently incorporated with a capital stock of $200,000, is planning to develop a water-power site on the Chippewa River, and to construct a hydroelectric power plant north of Eau Claire.

EAU CLAIRE, WIS.—Contract (general) has been awarded by the Dells Paper & Pulp Company of Eau Claire for the construction of a new paper mill and power plant, to A. Larson & Company, 414 Main Street. The cost is estimated at $125,000. Plans were prepared by L. A. DeGuere of Grand Rapids, consulting engineer, who is purchasing power-plant equipment and paper-mill machinery. W. L. Davis, Sr., is president.

KAUKAUNA, WIS.—Plans have been prepared by W. B. Montgomery, engineer of Montgomery, for remodeling dam and for other improvements for the Green Bay & Mississippi Canal Company. The installation of new generator, waterwheels, gates, sluiceway, etc., is included in plans.

MARSHFIELD, WIS.—Plans have been completed by Childs & Smith, architects, People's Gas Building, Chicago, for the construction of the first unit of a new central continuation school. Bids will be asked by the Board of Industrial Education of Marshfield soon after Jan. 1. The cost of the building is estimated at $75,000. P. J. Kraus is secretary of the board.

MILWAUKEE, WIS.—The Standard Oil Company, Brumder Building, it is understood, will ask for bids in the spring for the construction of a garage on Thirty-second Street, and also a distributing station on Barclay Street, to cost $50,000 and $150,000 respectively. Schlinz & Bailey, 53 West Jackson Boulevard, Chicago, Ill., are engineers.

SHEBOYGAN, WIS.—Plans are being prepared by W. C. Weeks, architect, Sheboygan, for the construction of a telephone exchange for the Citizens' Telephone Company.

ROCHESTER, MINN.—A special election will soon be held to vote on the proposal to issue $300,000 in bonds for the construction of a new municipal electric light plant.

ST. PAUL, MINN.—Plans have been prepared by L. Bassindale, architect, Capital Bank Building, St. Paul, for the construction of a hospital building for the Cobb Hospital Association, to cost about $400,000.

CEDAR RAPIDS, IOWA.—The Iowa Electric Company of Cedar Rapids will soon complete its high-tension line connecting the hydroelectric plant at Anamosa with the steam generating plant at Maquokato. This line will serve the various systems of the company in eastern Iowa.

EXCELSIOR SPRINGS, MO.—The Excelsior Springs Light & Power Company is considering extending its electrical service to the towns of Holt, Kearney, Lawson, Polo and other towns in this section.

ST. LOUIS, MO.—Contracts will soon be awarded by the Christian Brothers College for the erection of a college building on Clayton Road, to cost about $200,000. H. P. Hess, 4811 Côte Brillante Avenue, is architect.

SPRINGFIELD, MO.—Plans are reported to be under consideration for an annex to the power plant at the Frisco Railroad shops for the Springfield Gas & Electric Company.

MUNICH, N. D.—Bonds to the amount of $3,500 for the installation of an electric lighting system have been authorized.

VOLIN, S. D.—The installation of electric light and water systems are under consideration, and bonds have been voted for them.

COLONY, KAN.—The Colony Electric Light Company, recently organized, is planning to install an electric plant here. Equipment for the power house, including a Fairbanks-Morse 25-hp. engine and a 15-kw. generator, has been purchased. The plant, it is expected, will be in operation within thirty days.

Southern States

LUMBERTON, N. C. — The Lumberton Fiber Company is considering the completion of a fiber mill to be equipped with electrically operated machinery. F. M. Huggins is manager.

SAVANNAH, GA.—Work has begun on the construction of a new electric power plant at the shipbuilding works of the Foundation Company at Savannah.

SAVANNAH, GA.—The City Council has approved the petition of the Savannah Electric Company to erect a new electric transmission line west of the city to supply energy to industries in that vicinity.

EAU GALLIE, FLA.—Steps have been taken to organize a company, to be known as the Eau Gallie Utilities Company, to establish an electric plant here. The company will be capitalized at $30,000. F. D. Fant of Savannah will be president of the company.

MEMPHIS, TENN.—The County Commissioners are considering the installation of a lighting plant at the court house to supply electricity for lighting the building and operating the elevators. The cost is estimated at about $12,000.

KNOXVILLE, TENN.—Plans, it is reported, are being prepared by Miller, Fullenwider & Dowling, 6 North Michigan Avenue, Chicago, Ill., for the erection of a gymnasium, to cost $170,000, for the University of Tennessee. The construction of an administration building, to cost $500,000, and an armory, to cost $150,000, at the university is also under consideration.

PASCAGOULA, MISS.—The construction of a new power plant is reported to be under consideration by the Pascagoula Street Railway & Power Company.

BENTON, ARK.—An ordinance creating an electric light improvement district has been passed by the City Council. As soon as possible the local plant will be taken over by the municipality.

LEVY, ARK.—Arrangements have been completed by the City Council for the installation of a new lighting system.

MUSKOGEE, OKLA.—Plans, it is reported have been completed for the construction of an electric railway to connect Muskogee, Oklahoma City and Tulsa, to cost approximately $10,000,000. All surveys have been made and the project financed, and the promoters, it is said, are waiting for more normal conditions. R. D. Long and Edgar Graham, both of Muskogee, are interested in the project.

OKMULGEE, OKLA.—Preparations are being made by the Okmulgee Ice & Light for extensions to its electric and ice plants, including the installation of a 1250-kva. turbo-generator and a 50-ton ice plant with two 400-hp. boilers, stack, etc. Most of the equipment, it is understood, is purchased.

TISHOMINGO, OKLA.—Plans, it is reported, are under consideration for the construction of a new electric light plant in Tishomingo, to cost about $18,000.

CISCO, TEX.—The Cisco Gas & Electric Company, it is reported, is contemplating the reconstruction of its buildings, including power and ice plants. The company is controlled by the American Public Service Company of Chicago, Ill.

FORT WORTH, TEX.—The Gulf Well Machinery & Manufacturing Company, it is reported, is considering the construction of a power plant in connection with its proposed new works, which will include machine shop, pattern shop, forge shop, foundry and other buildings.

FORT SCOTT, KAN.—The sale of the property of the Fort Scott Gas & Electric Company on Jan. 18 has been announced by Judge E. C. Gates.

HOUSTON, TEX.—Bids will be received by E. E. Sands, city engineer, until Jan. 10, for improvements to waterworks system, including seven deep wells, deep-well pumps, motor and electric generators.

SHINER, TEX.—The City Council, it is reported, has decided to lease the electric light plant. The city will retain the control of the water system and will secure energy from the lessee of the electric plant to operate the water system and to light the streets.

Pacific and Mountain States

BREMERTON, WASH.—At an election held recently the proposal to issue bonds for the installation of a new electric lighting system was defeated.

TWISP, WASH.—The Twisp Roller Mills & Power Company, recently incorporated, it is reported, will operate an electric plant in this vicinity. The company is capitalized at $30,000. H. C. Lewis and J. M. Pate are interested in the company.

LOMPOC, CAL.—The City Council has passed an ordinance granting the Santa Barbara Telephone Company permission to erect and operate poles and wires, etc., for the transmission of electricity, and for telephone and telegraph purposes in Lompoc.

PLACERVILLE, CAL. — The Western States Gas & Electric Company is considering a petition to extend its electric service to Diamond Springs. The company also contemplates considerable extension to its service in El Dorado County during the coming year. Twin Lakes and other power stations are under construction.

SAN DIEGO, CAL.—The San Diego Electric Railway Company has begun work on the construction of an extension of its system to the local shipbuilding plant. The cost of the work is estimated at $50,000.

TRACY, CAL.—Plans are under consideration for the installation of electroliers along Central Avenue and the business section of Sixth Street. Electrical service is supplied by the Sierra & San Francisco Power Company of San Francisco.

CASPER, WYO.—At a meeting of the citizens held recently, a committee was appointed to submit a proposal to the City Council for the construction or purchase of a municipal lighting plant.

CASA GRANDE, ARIZ.—Plans are under consideration for establishing an electric power plant in Casa Grande.

BOULDER, COL.—The Cities' Service Company has purchased the control of the Western Light & Power Company, which operates in Boulder, Berthound, Fort Collins, Windsor, Superior, Loveland, Greeley, Louisville, Lafayette and other points in Northern Colorado. Improvements involving an expenditure of over $1,000,000, it is understood, are contemplated.

Canada

ROSSLAND, B. C.—The West Kootneay Power & Light Company is erecting a high-tension transmission line from its power station at Bonnington Falls to Northport and Princeton via Trail. The cost of the line is estimated at $1,000,000, and it will furnish electricity to smelting companies at Northport, Wash., and Princeton, B. C.

Directory of Electrical Associations

Printed in the First Issue of Each Month

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, A. H. Krom, 29 South La Salle St., Chicago, Ill.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 8 West Fortieth St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

AMERICAN PHYSICAL SOCIETY. Secretary, Prof. A. D. Cole, Ohio State University, Columbus, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS. University of Pennsylvania, Philadelphia, Pa.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, W. J. Tharp, Little Rock, Ark. Annual meeting, Fort Smith, Ark.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, C. E. Dustin, 30 East 42d St., New York City.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, H. T. Edgar, Stone & Webster, Boston, Mass.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & North Western Railway, Chicago, Ill.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary-treasurer, W. Volkman, Toronto Power Company, 12 Adelaide St. East, Toronto, Ont.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, T. F. Kennedy, 900 15th St., Denver, Col.

COMMERCIAL SECTION, N. E. L. A. Secretary, Henry Harris, Pittsburgh, Pa.

EASTERN NEW YORK SECTION, N. E. L. A. Assistant secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

ELECTRICAL MANUFACTURERS' CLUB. Secretary, Shiras Morris, Hart & Hegeman, Hartford, Conn.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, PACIFIC COAST DIVISION. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRIC POWER CLUB, Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill.

ELECTRIC VEHICLE SECTION OF THE N. E. L. A. Secretary, A. Jackson Marshall, 29 West 39th St., New York City.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York City.

FLORIDA ENGINEERING SOCIETY. Secretary, J. R. Benton, Gainesville, Fla. Annual meeting, Jacksonville, Jan. 5.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary-treasurer, R. V. Prather, Springfield, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donohue, Lafayette, Ind.

INDUSTRIAL ELECTRIC HEATING ASSOCIATION. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

INSTITUTE OF RADIO ENGINEERS. Secretary, Alfred N. Goldsmith, College City of New York, New York.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex. Annual meeting, Chicago.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA SECTION, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa.

JOVIAN ORDER. Jupiter (president), Henry J. F. Strickland, Dallas, Tex.; Mercury (secretary), E. C. Bennett, Syndicate Trust Building, St. Louis, Mo.

KANSAS PUBLIC SERVICE ASSOCIATION. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kan.

MICHIGAN SECTION, N. E. L. A. Secretary, Herbert Silvester, Detroit Edison Co., Detroit, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, H. C. Hoffman, St. Paul Gas Light Co., St. Paul, Minn.

MISSISSIPPI ELECTRIC ASSOCIATION. Affiliated with the N. E. L. A. Secretary-treasurer, L. D. Gordon, Jackson Light & Traction Co., Jackson, Miss.

MISSOURI ASSOCIATION OF PUBLIC UTILITIES. Secretary-treasurer, F. D. Beardslee, 721 Locust St., St. Louis, Mo.

NATIONAL ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary, H. C. Brown, 110 West 40th St., New York City, N. Y. State associations in Alabama, Arkansas, Connecticut, Georgia, Kansas, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee and Wisconsin.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, 33 West 39th St., New York City.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, R. W. McGinnis, O'Neil Light & Creamery Co., O'Neil, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 15 State St., Boston, Mass. Annual meeting, Boston, Mass., June.

NEW ENGLAND SECTION, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NEW MEXICO ELECTRICAL ASSOCIATION. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M. Annual meeting, Albuquerque, N. M., Feb. 17-19.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Secretary, Franz Neilson, 120 Broadway, New York City.

NEW YORK ELECTRICAL SOCIETY. Secretary, George H. Guy, 29 West 39th St., New York City.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Affiliated with N. E. L. A. Secretary, George L. Myers, Pacific Power & Light Co., Portland, Ore.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

OKLAHOMA UTILITIES ASSOCIATION. Secretary H. A. Lane, 611 State National Bank Building, Oklahoma City. Annual meeting, Feb. 13, 14 and 15, Oklahoma City.

PACIFIC COAST SECTION, N. E. L. A. Secretary, A. H. Halloran, 618 Mission St., San Francisco, Cal.

PENNSYLVANIA ELECTRIC ASSOCIATION, State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa.

PUBLIC SERVICE ASSOCIATION OF VIRGINIA. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

RADIO CLUB OF AMERICA. Secretary, T. J. Styles, 152 Beach St., Yonkers, N. Y.

ROCKY MOUNTAIN ASSOCIATION OF MUNICIPAL ELECTRICIANS. President, Lawrence Stone, Denver, Col.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, 29 West 39th St., New York City.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

SOUTH DAKOTA ELECTRICAL POWER ASSOCIATION. Secretary-treasurer, O. J. Gronsdahl, Hartford, S. D.

SOUTHEASTERN SECTION, N. E. L. A. Secretary-treasurer, T. W. Peters, Columbus, Ga.

SOUTHERN CALIFORNIA ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex.

SOUTHWESTERN SOCIETY OF ENGINEERS. Secretary, C. E. Barglebaugh, 703 First National Bank Building, El Paso, Tex.

TORONTO ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont.

TRI-STATE WATER AND LIGHT ASSOCIATION. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C. Annual meeting, Greenwood, S. C., April.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, A. B. Marsden, Rutland, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill. Annual meeting, Chicago, Jan. 28-30.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill. Annual meeting, Chicago, January.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, J. P. Pulliam, 1408 First National Bank Building, Milwaukee, Wis. Annual meeting, Milwaukee, March 25-27.

(Issued Nov. 26, 1918)

1,285,806. Metal-Vapor Rectifier and Similar Apparatus; Bela Schaefer, Frankfort-on-the-Main, Germany. App. filed July 23, 1912. To provide in connection with the vacuum chamber a simple and efficient externally situated cooling or condensing chamber or chambers.

1,285,809. Electric Motor and Transmission System for Locomotives and Other Purposes; S. S. Seyfert. App. filed Feb. 2, 1914. Permitting field and armature, or primary and secondary members of motor, to rotate in opposite directions, greatly increasing their relative speeds.

1,285,831. Galvanic Cell; Howard A. Stofflet, Reading, Pa. App. filed Nov. 22, 1916. For primary batteries.

1,285,840. Attachment Plug; George B. Thomas, Bridgeport, Conn. App. filed Dec. 6, 1915. Having an associated pilot light for indicating the condition of the plug circuit.

1,285,874. Dynamo Brush Holder; Joseph L. Woodbridge, Philadelphia, Pa. App. filed Oct. 29, 1915. To eliminate any tendency to rock the brush or produce unequal pressure at different parts of the contact surface.

1,285,875. Electroplating Device; John E. Woodbury, Worcester, Mass. App. filed March 29, 1918. Designed particularly for repairing copper-printing plates.

1,285,905. Secondary Clock; Lawrence O. Beard, Lancaster, Pa. App. filed March 7, 1917. Relates particularly to such as employ mechanism controlled and actuated by electromagnetic means.

1,285,911. Electrical Measuring Instrument; Clarence A. Boddie, Pittsburgh, and William M. Bradshaw, Wilkinsburg, Pa. App. filed Sept. 10, 1915. To provide an instrument that is small in dimensions and economical to manufacture and that operates correctly on a wide range of load.

1,285,934. Electric Signal; Eric O. Carlson, Cleveland, Ohio. App. filed Dec. 29, 1917. Relates especially to single-variation annunciators which close a circuit and actuate a signal when an overload occurs on the line wire or apparatus adjacent.

1,285,940. Wireless-Telegraph Pole; Leon Chodakowski, Binghamton, N. Y. App. filed Dec. 22, 1917. Collapsible and for temporary use.

1,285,947. Vapor-Electric Apparatus; Frank Conrad, Swissvale, Pa. App. filed Sept. 18, 1911. Means are provided for preventing short circuits between the positive electrodes and also for preventing the occurrence of arcs between the positive electrodes and the casing.

1,285,962. Electrical Connector; Albert F. Esler, Rochester, N. Y. App. filed July 2, 1917. For coupling electrical appliances to a suitable source of supply.

1,285,965. Vapor-Rectifier; Sidney W. Farnsworth, Pittsburgh, Pa. App. filed Oct. 31, 1914. Quiet, efficient and stable operation secured in vacuum vapor apparatus by the control of the relative temperatures of the electrodes.

1,285,966. Cathode Structure for Vapor Converters; Sidney W. Farnsworth, Pittsburgh, Pa. App. filed Dec. 2, 1915. Condensed cathode material may be cleansed from dirt and returned to a position for active use with little or no disturbance of the normal operation of the apparatus.

1,285,967. Shielding Apparatus for Vapor Converters; Sidney W. Farnsworth, Pittsburgh, Pa. App. filed Dec. 2, 1915. Arc may be effectively freed from all but current-carrying particles, and short-circuiting, reverse arcing and allied phenomena may be prevented.

1,285,969. Telephone System; Frank L. Fisher, Decatur, Ill. App. filed Jan. 24, 1916. Relates to prepay boxes designed for use in automatic signaling.

1,285,970. Prepay Box for Telephone; Frank L. Fisher, Indianapolis, Ind. App. filed March 22, 1917. Coils control disposition of coin in automatic systems.

1,285,971. Hatching Apparatus; Charles S. Forbes, Strathdon, Scotland. App. filed March 8, 1916. Air entering two side compartments flows upward past the heating devices and the water inward over the upper edges of the partitions and down through the eggs, escaping from the intermediate egg compartment below the level of the eggs.

1,285,977. Inductive High-Tension Terminal; Harry D. Garrettson, New York, N. Y. App. filed May 28, 1918. A corrugated insulator with a bore containing an inductive resistance for protecting the transformer on which it is mounted from electrical troubles.

Record of Electrical Patents

Notes on United States Patents

1,285,986. Rain Alarm; Russell D. Grafford, Marshall, Mich. App. filed Dec. 14, 1917. Does not operate under light showers.

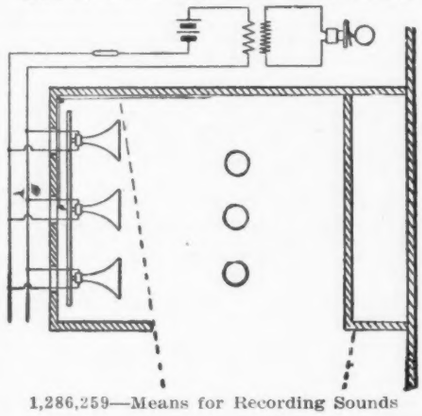
1,286,001. Automatic Switch; Henry A. Hoeschen and William H. Hoeschen, Omaha, Neb. App. filed April 2, 1917. For controlling an electric motor circuit or the like.

1,286,010. Suspension Device; Ray P. Jackson, Edgewood Park, Pa. App. filed Dec. 8, 1915. For insulators; may be readily assembled or separated without the use of tools.

1,286,013. Electric Motor; Harry W. Jeannin, Warren, Ohio. App. filed Sept. 18, 1916. The usual shell or frame is eliminated and the end plates are connected directly with the field.

1,286,030. Reinforced Hard-Rubber Structure; Edwin J. Kroeger, Akron, Ohio. App. filed July 25, 1918. Relates to mode of embedding a suspending plate in the wall of a hard-rubber receptacle, such as a large storage-battery jar.

1,286,034. Vibrator; Oscar M. Leich, Genoa, Ill. App. filed May 18, 1916. Battery used to supply equalizing current.



1,286,259—Means for Recording Sounds

1,286,050. Rectifying System; Friedrich W. Meyer, Pittsburgh, Pa. App. filed March 24, 1915. When current from a plurality of independent circuits is rectified in one evacuated space, the rectifying arcs may be maintained entirely separate and distinct from each other.

1,286,062. Method of Attaching Fuse Tubes to Hand Grenades of Thin Metal; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed July 15, 1918. To make an integral joint between the parts and to avoid burning of metal.

1,286,063. Method of Making Electric Fuses; Thomas E. Murray, New York, N. Y. App. filed Nov. 20, 1917. Fuse ends are plugged with plaster of Paris.

1,286,100. Electric Furnace; Bjorn Raeder, Kykkerlsrud, Askim, Norway. App. filed Jan. 22, 1918. To provide means whereby the supply of the slag charge is easily controlled.

1,286,101. Circuit Interrupter; Karl C. Randall, Edgewood Park, and Howard G. McDonald, Murraysville, Pa. App. filed Oct. 21, 1916. To provide a single operating means for a plurality of circuit interrupters that shall be adapted to permit either simultaneous or successive closing and successive opening of the interrupters.

1,286,103. Contact Shoe for Electric Cranes; Luther P. Reed, Schenectady, N. Y. App. filed May 9, 1918. To maintain the contact device in proper sliding engagement with the conductor wire.

1,286,130. Supply System for Railway Vehicles; Karl A. Simmon, Wilkinsburg, Pa. App. filed Sept. 5, 1916. To eliminate vibration of vehicle.

1,286,131. Telephone System; Frank M. Slough, Elyria, Ohio. App. filed Aug. 14, 1914. To perform automatically many operations now done normally.

1,286,135. Apparatus for Subjecting Gases to the Action of Heat and Pressure; Edward E. Somermeier, Englewood, Fla. App. filed April 26, 1917. Heated reaction chamber is inclosed in a strong pressure chamber.

1,286,148. Switch Mechanism; William D. Throop, Norwich, Conn. App. filed May 14, 1917. Minimum amount of effort required to operate the switch, which has no dead center.

1,286,175. Ignition Device for Internal-Combustion Engines; Albert Erickson, Chicago, Ill. Relates to the make-and-break type, wherein the ignition current is supplied by a magneto-generator of the plug oscillatory type.

1,286,180. Automatic Telephone Exchange; Alexander E. Keith, Hinsdale, and John Erickson and Charles J. Erickson, Chicago, Ill. App. filed May 4, 1903. Enabling the different subscribers of an electrical exchange to call each other by mechanism, preferably automatic, at the central exchange.

1,286,182. Starting and Lighting Apparatus; Bennett M. Leece, Cleveland, Ohio. App. filed Dec. 22, 1913. For engine-driven vehicles.

(Issued Dec. 3, 1918)

1,286,207. Insulator Bracket; Paul M. Benedict, New Haven, Conn. App. filed March 8, 1916. To provide means for effectively securing the pin or cob on the bracket.

1,286,221. Electrical Protective Device; Harold W. Brown, Ithaca, N. Y. App. filed March 18, 1914. Relay of the motor type has a large range of speed control, thus allowing either a definite or an inverse time limit in its operation.

1,286,230. Electric Soldering Iron; John G. Clemens, Buffalo, N. Y. App. filed Dec. 5, 1917. Tip is quickly heated by two spaced carbons.

1,286,239. Electrical Protective Device; Almon W. Copeley, Pittsburgh, and Jenjamin H. Smith, Turtle Creek, Pa. App. filed June 30, 1916. A time-limit relay having electrical means for obtaining its time-limit functions.

1,286,242. Soldering Tool; Jasper F. Cullin, Detroit, Mich. App. filed April 4, 1918. Solder contained therein is melted by an electric current passing through the solder.

1,286,243. Commutator and Holding Means Therefor; Charles W. Dake, Chicago, Ill. App. filed Sept. 21, 1917. Commutator supported and reinforced so that it will not fly out of position or be distorted under high-speed conditions.

1,286,247. Apparatus for Treatment of Magnetic Ore; Edward W. Davis, Minneapolis, Minn. App. filed May 18, 1916. Magnetite ore may be demagnetized and when once classified may be again magnetized and collected.

1,286,259. Means for Recording Sounds; Thomas A. Edison, Llewellyn Park, West Orange, N. J. App. filed March 6, 1913. Sound waves collected at a plurality of points are collected and transmitted to a single recording device.

1,286,316. Electric Translating Apparatus; Peter G. Hewitt, Ringwood Manor, N. J. App. filed Oct. 20, 1913. Gas or vapor lamp may be started with a direct current of low voltage.

1,286,351. Electric Selective System; Howard L. Krum, Chicago, Ill. App. filed May 31, 1910. For printing telegraphs and the like.

1,286,357. Switch; Sam G. Langley, Maplewood, N. J. App. filed June 18, 1912. Relates to an automatic switch adapted to act as a relay for apparatus carrying large currents.

1,286,364. Relay; Harold S. Loomis, Wilkinsburg, Pa. App. filed July 23, 1917. Adapted for use in railway signaling.

1,286,373. Method of and Apparatus for Making Electrical Measurements; Ervan L. McDonald, Salt Lake City, Utah. App. filed May 8, 1914. Relates to an adjustable inductance coil adapted for use in connection with electric circuits connected to alternating or pulsating electromotive forces.

1,286,381. Connecting Stud and Bond Terminal; George A. Mead, Mansfield, Ohio. App. filed June 14, 1917. To be secured within a hole in the rails by means of an explosive force within the stud or terminal.